

NASA Contractor Report 3910

High Speed Ice Accretion on Rotorcraft Airfoils

Robert J. Flemming and David A. Lednicer

United Technologies Corporation

Sikorsky Aircraft Division

Stratford, Connecticut

Prepared for

Lewis Research Center

under Contract NAS3-23049

~~Unclassified - Distribution limited
to U.S. Government agencies
and their contractors~~



1985

Restriction changed to Unclassified/Unlimited per DAA modified February 15, 2008, by authority of the NASA Glenn Research Center, Icing Branch Office.



FOREWORD

The high speed ice accretion contract was assisted by the Ohio State University under grant NAG3-109 and by the National Research Council (NRC) of Canada under an April 1982 agreement. Dr. John Lee and Richard Freuler provided assistance during the preparation and conduct of the high speed icing test and conducted the dry transonic tests at the Ohio State University. Ronald Price and T. R. Ringer of NRC and Rory Harding of Hovey and Associates provided test support and guidance during the NRC phases of the program. Further technical assistance was given by Dr. R. J. Shaw and G. Paul Richter of NASA's Lewis Research Center.

PRECEDING PAGE BLANK NOT FILMED

TABLE OF CONTENTS

	<u>Page</u>
Foreword	iii
Summary	1
Introduction	2
Test Apparatus	3
NRC High Speed Icing Wind Tunnel	3
OSU 6X22 Transonic Airfoil Facility	5
Airfoil Models	5
Test Procedure	7
NRC Artificial Icing Test	7
OSU Simulated Ice Test	7
Error Analysis	8
NRC Icing Test Results	9
Baseline Data	9
Ice Shapes	11
Force and Moment Data	14
Icing Relationships	16
Lift Increment Prediction	17
Drag Increment Prediction	18
Pitching Moment Increment Prediction	19
Thickness Prediction	20
Shedding Prediction	22
Prediction Codes	23
Comparisons with Bragg and Gray Correlations	24
Correlation with Rotorcraft Flight Data	25
OSU and NRC Simulated Ice Test Results	28
Conclusions	30
Recommendations	31
Tables	33
Figures	39

TABLE OF CONTENTS (Cont'd)

	<u>Page</u>
Appendix A - Run Log and Tabulated Test Data - NRC Phase 1 Test	141
Appendix B - Run Log and Tabulated Test Data - OSU Simulated Ice Test	174
Appendix C - Run Log and Tabulated Test Data - NRC Phase 2 Test	185
Appendix D - NRC Clean Airfoil and Simulated Ice Test Data	199
Appendix E - OSU 6 x 22 Clean Airfoil and Simulated Ice Test Data	229
Appendix F - Two-Dimensional Airfoil Icing Prediction Code	274
Appendix G - Rotorcraft Icing Prediction Subroutine	284
Appendix H - Symbols	294
References	296

SUMMARY

A three-phase, high-speed, model scale icing wind tunnel test program has been conducted to measure ice growth and the associated performance degradation for two-dimensional helicopter airfoils over a wide range of angle of attack and Mach number. Prior to these tests, conducted in the Canadian National Research Council's High Speed Icing Wind Tunnel and the Ohio State University 6 x 22 Transonic Airfoil Facility, airfoil icing data had either been acquired in low speed wind tunnels or during flight testing. Information from a low speed wind tunnel is useful, but its applicability to the high speed domain was uncertain. Flight testing can provide a good means of determining capabilities and power penalties of a particular rotor design, but conditions cannot be well controlled, do not cover a wide range, and are difficult to observe. High speed icing information, as reported in this report, is necessary to predict the effect of icing on rotor performance and to aid in the design of more efficient ice protection systems. Ice was accreted on ten rotorcraft airfoil models for ranges of liquid water content, temperature, and Mach number at several steady and unsteady angles of attack. The test explored the temperature boundary for the onset of ice accretion, as well as the boundary between wet and dry ice growth. Ice shapes were documented by measurement, photographic, and silicone rubber molding techniques and aerodynamic lift, drag and pitching moment levels were measured.

In moderate icing conditions, the airfoil lift at low angles of attack was reduced slightly, with a maximum of about 20% at high angles. The drag coefficients of these airfoils increased in moderate icing at low angles of attack by a factor of 3 to 4 above the drag of a clean airfoil. The drag increment increased for angles of attack above six degrees and higher liquid water contents. The effect of Mach number varied for each airfoil configuration. Airfoil oscillation did not change the lift loss, but reduced the drag penalty.

The data from this series of tests was used to formulate two-dimensional airfoil section icing relationships for ice thickness and for changes in lift, drag, and pitching moment coefficients. These relationships contain variables that are known to be significant for airfoil icing and include empirical constants and terms to provide a rapid prediction method, with improved accuracy over prior relationships.

The two-dimensional relationships have been incorporated into rotorcraft hover and forward flight performance prediction codes, which can then be used to predict aircraft power changes in the icing environment and to optimize the design of rotor deicing systems.

INTRODUCTION

The potentially hazardous effects of ice accretion on the aerodynamic surfaces of aircraft have long been recognized. NACA and the fixed wing industry initiated efforts to understand and counter the aircraft icing problem in the 1920's and increased the level of research activity during the 1940's and 1950's. These efforts concentrated on airfoil sections applicable to fixed wing aircraft and the lower speed range associated with most fixed wing icing encounters. Renewed interest in icing research, including rotorcraft icing research, began in the late 1970's.

In order to realize the helicopter's full potential, it must become capable of flying in forecast icing conditions and during inadvertent icing encounters. However, the existing data base on ice accretion and its effects has been insufficient to fully understand and predict the rotor ice accretion phenomenon. The data base can be expanded by testing in natural icing clouds or artificial icing facilities (icing tunnels and spray rigs), or through the use of simulated ice bonded to the test article. To expand the data base, NASA supported the artificial ice testing of ten two-dimensional models in the NRC High Speed Icing Wind Tunnel to Mach numbers up to 0.7 and several simulated ice configurations in both the NRC tunnel and the Ohio State University Transonic Airfoil Facility. The objectives of this test include:

- 1) The acquisition of two-dimensional rotorcraft airfoil performance data with ice accretion over a range of environmental conditions representative of the helicopter rotor.
- 2) The determination of the effects of airfoil pitch oscillation on ice accretion.
- 3) The determination of the ability to obtain representative aerodynamic data from simulated ice shapes.
- 4) The development of empirical ice accretion and incremental lift, drag and pitching moment relationships.
- 5) The determination of the ability to represent full-scale helicopter ice shapes.

The content of the high speed ice accretion program is shown schematically in figure 1.

TEST APPARATUS

NRC High Speed Icing Wind Tunnel

The NRC High Speed Icing Wind Tunnel at the National Research Council facility in Ottawa, Ontario, used in the first and third parts of this test program, is a closed circuit wind tunnel refrigerated by a three stage ammonia plant which cools the tunnel finned-tube heat exchanger. The test section is 30.48 cm (12 in) square by 45.72 cm (18 in) long. The two stage axial compressor is powered by a 600 HP DC motor. Static temperatures as low as -40°C can be attained. Water spray is formed by up to 23 atomizing nozzles upstream of the test section. Icing can be simulated for 20 micron droplets for liquid water contents (LWC) up to 2 grams per cubic meter. The tunnel, shown in figures 2 and 3, has seen limited use in its high speed configuration; most of the testing has been with a low speed insert which limits maximum speed to approximately 155 mps (300 knots). The empty high speed test section has a maximum Mach number of 0.86. With the OSU wake probe in its full down position this is reduced to 0.81. The installation of the airfoil test models reduced the Mach number to a maximum of 0.77. The maximum speed is limited by the maximum RPM of the fixed pitch compressor, not tunnel power. Figure 4 shows the tunnel compressor speed characteristics determined during this test.

The water spray to produce the artificial icing cloud can be generated by up to five spray bars, each with 4 to 5 nozzles. Only three spray bars were installed for this test, as shown in figure 5. The test was normally run using only one spray bar to provide a more uniform ice pattern across the tunnel, but for some high Mach number conditions the three-bar configuration was required to produce uniform ice. The air pressure to obtain droplet sizes of twenty microns is shown in figure 6 for both one and three spray bar configurations. The LWC calibrations, using three spray bars, and a single-bar are shown in figure 7. These plots are presented in terms of the test facility flow meter (flowrater tubes), which contain balls of different density to indicate the flow rate through the spray system. The calibration data was faired uniformly using a carpet plotting technique which provides an indication of data quality. While the data generally fall within 0.05 g/m³ of the data fairings, a number of points deviate from the mean line by up to 0.10 g/m³. The data for three spray bars at low Mach number contains even greater scatter, indicating nozzle instability at this condition and the higher flow data at a Mach number of 0.6 (fig. 7b) gave lower LWCs than expected due to droplet freezeout or droplet runoff on the rotating cylinder icing rate probe (i.e., condition may exceed the Ludlam limit).

A remotely controlled angle of attack drive system was designed and fabricated for this test. Shown in figure 8, this apparatus consists of bearing-supported discs which have a rectangular opening to hold contoured blocks that secure the airfoil models. Steady angle of attack is controlled by a motor-gear assembly over a range of -10 to +20 degrees. Oscillatory angle, to simulate the inflight variation of a helicopter blade angle, was provided by a 90 psi pneumatic actuator. Frequencies up to 10 Hertz and amplitudes up to ± 4.5 degrees can be provided around the semi-chord point on the airfoil. Viewing ports forward of the drive mechanism are provided for visual and video viewing of the ice formation.

The test section floor and ceiling panels were replaced by porous plenum chambers, shown in figure 9. The porosity of each plate was 178 square centimeters (27.6 sq. in.) for a test section porosity of 10%. These separated plenum chambers had been shown in prior OSU testing to reduce tunnel interference for airfoil testing (see ref. 1).

The momentum loss behind the airfoil was measured by a traversing wake probe (fig. 10). The probe was moved across the wake at a speed of 2.5 cm/sec (1.0 in/sec) at a data acquisition rate of 5.6 samples per second. The pitot probe extends 5 cm (2 in) forward of its faired support and has a maximum range of travel from the tunnel ceiling to 7.6 cm (3 in) above the floor. Probe outside and inside diameters are .158 and .107 cm (.062 and .042 in), respectively. The probe head was approximately 1.9 chord lengths from the airfoil trailing edge. Probe-to-model separation and traversing speed were investigated during the test and found to have little effect on the data.

A 48-port Scanivalve was used to measure 40 airfoil static pressures and 8 tunnel pressures. Three additional pressure transducers measured the wake probe total pressure and provided a redundant measurement of tunnel static pressure and differential pressure between the floor and ceiling at the front of the test section. Two rotary potentiometers measured the steady and oscillatory airfoil angles and a 23 kilogram (50 pound) load cell reacted airfoil pitching moment. Tunnel temperatures and spray properties were taken from tunnel gauges.

The data were recorded using the OSU Digital Data Acquisition and Recording System (DDARS). This system consists of a power supply, analog to digital conversion unit, minicomputer, floppy disc unit, and typewriter terminal. Additional information on the DDARS may be found in reference 2.

OSU 6 X 22 Transonic Airfoil Facility

The OSU 6 X 22 airfoil wind tunnel, used during the cast ice phase of the test program (figure 11), is a blowdown tunnel. The dimensions of the test section are 15.24 cm (6 in) by 55.83 cm (22 in) by 111.76 cm (44 in) long. The side walls are solid while the upper and lower walls are perforated with a porosity of 10%. The upper and lower plenums are connected only through the downstream mixing zone and have been shown to provide low interference for airfoil testing. The models are mounted between two ports in the sidewalls. Angle of attack is controlled manually and Mach number can be varied from 0.2 to 1.1. Total pressure can be controlled to provide a wide range in Reynolds number. The OSU testing used the Scanivalve and data acquisition system of the NRC test and a wake probe similar to that of the NRC probe. More information on the OSU facility can be found in reference 3.

Airfoil Models

A total of ten airfoil models were used during these tests. The dimensional characteristics of these models are:

<u>Airfoil</u>	Configuration No.		Chord	Planform Area, <u>cm² (in²)</u>	¹
	<u>NRC</u>	<u>OSU</u>	<u>t/c</u>	<u>cm (in)</u>	
NACA 0012 ²	1, 8	1	.120	15.24 (6.00)	464.5 (72.00)
SC1095	2	5	.095	15.24 (6.00)	464.5 (72.00)
SC1094 R8	5	14	.094	15.39 (6.00)	473.9 (73.45)
SC1012 R8	6	17	.120	15.39 (6.00)	473.9 (73.45)
SSC-A09	3	8	.090	15.24 (6.00)	464.5 (72.00)
VR-7	4	11	.120	16.21 (6.38)	493.9 (76.56)
OH-58 Tail Rotor Blade	7	20	.120	13.34 (5.25)	355.9 (55.13)
NACA 0011.5	12	-	.115	6.83 (2.69)	208.3 (32.28)
Circulation Control	17	-	.213	15.24 (6.00)	464.5 (72.00)

¹ For models installed in NRC tunnel. Areas are half these values for OSU tunnel.

² One model with pressure taps and one with an internal thermocouple.

Photographs of the airfoil models are shown in figure 12. Contours are shown in figure 13. The NACA 0012 models were molded from an aluminum-epoxy mixture and anodized to provide a smooth finish. The VR-7 model was machined steel and the OH-58 tail rotor blade (NACA 0012 airfoil) was a standard flight-worthy aluminum blade that incorporated an out-of-contour leading edge abrasion strip. The NACA 0011.5 model was a section of an aluminum model rotor blade. The remaining five models were machined from stainless steel. The SC1095 airfoil was modified by the addition of an epoxy-fiberglass leading edge piece to form the SC1094 R8 model.

The models were selected to provide a range of rotorcraft airfoil contours while using existing model hardware where feasible. The NACA 0012 represents the first generation of helicopter airfoils and the VR-7 and the SC1095 family represent airfoils in use on current production helicopters. The SSC-A09 and circulation control models are advanced airfoils. The OH-58 tail rotor was included in this program to provide baseline, two-dimensional data for a rotor test program planned for the NASA Lewis Icing Research Tunnel, and the NACA 0011.5 model was included to provide scale effect information.

The information contained in this report is generally for .1524m (6 inch) chord airfoils. The similitude relationships contained in reference 4 indicate that, for a full scale chord of 16 inches, the equivalent full scale droplet diameter is 37 microns and the liquid water content and icing time are .8 and 3.2 times the model scale values, respectively.

Molds of sixteen ice shapes (see Table I) were made using a silicone rubber that could cure in a sub-freezing environment. Experimentation by NASA and Sikorsky led to the use of Dow-Corning 3110 room temperature vulcanizing (RTV) silicone rubber for the ice molding. Other molding materials were rejected because of their slow cure rate in a subfreezing environment. Figure 14 illustrates the molding process and shows one of the sixteen molds made during the test. One part of Catalyst 4 was used in 150 parts of the 3110 base. No thinner was necessary. The RTV mixture was subjected to a vacuum for about 15 minutes to remove entrained air before use. After some mold material was poured into the mold box, the iced airfoil was set into it and additional mold material added to fill the box. The cured mold separated easily from the box and the model. These molds were used to fabricate epoxy-fiberglass castings of the ice shapes which were bonded to the airfoil models for use in the simulated ice tests (see fig. 15).

TEST PROCEDURE

NRC Artificial Icing Test

Baseline dry data for each airfoil were obtained over the operating range of the tunnel prior to the start of icing runs. In addition, a dry data point was normally taken before ice accretion to provide an assessment of data repeatability and to check the integrity of test instrumentation. Ice was accreted, with the airfoil either stationary or oscillating about the semi-chord point, from the water of a super-cooled cloud with a set liquid water content (LWC), droplet size and total temperature for a specified time. Following an icing encounter, one or more steady state data records consisting of tunnel parameters and airfoil pressures were taken. Following a run, planform and end view photographs were taken and then the ice was cut to permit the insertion of a template to allow a tracing of the ice shape onto the template. The ice was then measured to provide more quantitative information on the geometry of the ice formation. The potential matrix of icing test points was very large. Icing conditions were selected during the course of the testing to provide trending information for liquid water content, angle of attack and Mach number. Runs to define the effects of temperature, droplet size, and icing time were made for selected cases. The run schedules for the two NRC test phases are included in Appendices A and C.

Silicone rubber ice molds were made for a total of sixteen selected configurations. These molds provide an excellent representation of the ice and were used to produce simulated ice castings for the OSU test and for the NRC Phase 2 test.

OSU Simulated Ice Test

This phase of the test program involved the acquisition of aerodynamic data for a limited matrix of Mach number - angle of attack conditions for the clean airfoil and each ice shape. A casting is shown in figure 15. The run schedule for the OSU simulated ice test is included in Appendix B. A numerical summary of test conditions for the NRC and OSU test phases is given below.

	NRC Phase I	NRC Phase II	OSU	Totals
Run Numbers	1-1425	1426-1833	1834-2348	
Total Data Runs	1425	408	515	2348
Dry Runs*	775	157	174	1106
Simulated Ice Runs	0	231	62	293
Steady-state Ice Runs	281	0	127	408
Oscillating Ice Runs	56	0	7	63
Post Ice Data Runs	156	0	69	225
Non-Icing Research Runs**	40	0	38	78
Non-productive Runs	117	20	38	175

*No artificial ice or simulated ice

**Pitot probe, wake probe, boundary layer and turbulence studies
and spray bar calibration runs

The large volume of data precluded a comparative analysis of each artificial icing or simulated ice point as part of the current study. The reader is encouraged to use the data contained in the appendices to prepare additional figures.

ERROR ANALYSIS

An estimate of experimental errors for both the wind tunnel measurements and for the flight test data used for correlation has been made. The NRC High Speed Icing Wind Tunnel measurements have one σ deviations comparable to other facilities for clean airfoil testing (Table II). However, the variability that exists from one icing encounter to another for the same target set of test conditions results in much higher drag coefficient deviations for an iced airfoil. For example, the NACA 0012, tested repeatedly at a Mach number of 0.38 and at an angle of attack of 6 degrees, had a drag coefficient that ranged from .0114 to .0134, with a standard deviation of .0006. After 60 seconds of icing at an LWC of 0.48 g/m³, the drag coefficient ranged from .038 to .050, with a standard deviation of .0035. The lift and pitching moment deviations, with and without ice are similar. Table III presents the errors derived from the repeated test data for the lift, drag, and pitching moment coefficients and ice thickness. The relatively large data scatter must be considered

when analyzing the wind tunnel test data. It is also possible that the sources of the deviations observed in the wind tunnel contribute to the data scatter observed in flight test torque measurement when operating in icing conditions.

NRC ICING TEST RESULTS

Baseline Data

This test was the first high speed airfoil test in the NRC facility, and, therefore, the tunnel characteristics were unavailable prior to the test. No wind tunnel corrections have been applied to the test data. OSU conducted preliminary tests in their 6" x 12" wind tunnel (reference 1) to determine a porous wall pattern to provide acceptable airfoil surface pressure distributions, especially at higher Mach numbers. Figure 16 compares NRC tunnel SC1095 pressure distributions with those taken in the NASA Langley 6 x 28 tunnel (reference 5), full-scale data from the UTRC 8-foot wind tunnel (reference 6) and the airfoil analysis program of reference 7. At a nominal lift coefficient of 0.6 and a Mach number of 0.69 the NRC shock position matches the reference 5 data, but is 7% of the chord further forward of that shown by other facilities and theory. The pressure distribution is shifted to a higher negative value on the rear half of the airfoil at this high lift, high Mach number condition. At less severe conditions, the correlation is improved, as shown by the 0.49 Mach number data in figure 17.

The lift, drag and pitching moment data from the NRC tunnel are compared with data from other facilities in figures 18 and 19. Even though the NRC tunnel had a significant sidewall boundary layer, the maximum lift coefficient exceeds accepted values up to 10% at low Mach numbers and 20% at high Mach numbers. The drag values are greater at low angles of attack, with increasing error at higher angles due to a poorer pressure recovery at the trailing edge. This change in pressure recovery has a significant impact on the pitching moment, showing more negative moments at higher angles than prior tests have indicated.

Figure 20 shows the nominal test envelope for iced and non-iced conditions. For airfoils with high maximum lift angles (SC1094 R8 and SC1012 R8), the angle of attack range extended up to 18 degrees, and for the high speed airfoil (SSC-A09), the maximum Mach number reached 0.77. Without a model or the drag probe installed, the maximum Mach number for this tunnel was 0.86. The trends shown in figures 18 and 19 indicate some form of blockage

or tunnel interference at high lifts and high Mach numbers. The maximum allowable compressor RPM limited the test envelope for this test generally to conditions where the surface pressure coefficient correlation was acceptable. The tunnel boundary layer, measured using the traversing wake probe, was about 6 cm thick at low Mach numbers, increasing to 8 cm at a Mach number of 0.68 (see figure 21). The lower velocity airflow near the walls results in less ice accretion on the airfoil models near the wall (liquid water content measurements were made at the tunnel centerline). The potential for high turbulence being induced by spray bars in icing tunnels has been a concern of researchers. Tunnel turbulence was measured in the NRC tunnel using a hot wire anemometer and has a value of 1.8% of the free stream velocity (see figure 21). This is greater than good aerodynamic tunnels but is believed acceptable for icing work.

For icing cases where a limited number of airfoil surface pressure orifices are sealed during a test run, it is difficult to determine whether the airfoil pressure taps are providing correct integrated force and moment coefficients. Fortunately, the lift and moment error induced by blocked pressure taps near the leading edge are small. Figure 22 shows the lift and pitching moment sensitivity to a +0.5 increment in surface pressure coefficients (C_p) for one, two and three consecutive orifices. For a case where the three orifices near the leading edge are blocked during a run by ice that causes a 0.5 increment in C_p , the lift coefficient will be high by 0.016, within experimental accuracy (see Table III). The change in pitching moment is +.004, slightly greater than the estimate of experimental error.

In order to maintain a lift reference for cases where several airfoil pressure taps become blocked due to ice, two additional methods were used to determine lift coefficient. The first alternate method used the differential static pressure between the upper and lower plenum chambers. Based on correlation with the surface pressure derived lift of non-iced airfoils, the plenum lift coefficient is:

$$C_{l_{PL}} = \Delta C_{p_{PL}} \times 2.734 - 0.5 \times \text{Mach Number}$$

where $\Delta C_{p_{PL}}$ is the difference between the lower and upper plenum pressures, normalized by the dynamic pressure. Figures 23 and 24 show that this method works well for the models and Mach numbers tested.

The second alternate method uses the differential pressure between a pair of airfoil surface pressure ports on the upper and lower surfaces. A single relationship for the airfoils tested was derived using the 40% chord surface pressure data as the source of the calculated lift coefficient. Figures 25 and 26 show the correlation, based on the following relationship:

$$C_{l_{40}} = \Delta C_{P_{40}} \times 1.15 - .05$$

The latter method is very good prior to stall. Integrated airfoil surface pressure lift data were used for data evaluation when available. The plenum lift was used for the VR-7 and SC1094 R8 models, the untapped NACA 0012 model, and the OH-58 tail rotor and NACA 0011.5 (S-58) model rotor blades. Pitching moment was computed from an integration of the airfoil surface pressures. The pitching moment load cell, installed for the first part of the test, was affected by the freezing of condensation on moving parts and by the large static moment variation that was produced by the asymmetrical model support hardware. The measured load cell values were inaccurate and, therefore, not used.

Ice Shapes

Figure 27 illustrates the energy sources that affect the icing of an airfoil, emphasizing the complexity of the physics of icing. The type of ice on an airfoil is governed by the rate that the super-cooled water droplets freeze on the airfoil surface. The ice shapes that occurred during the test fall into two main categories: dry growth (rime) and wet growth (glaze). The wet growth category can be broken further into three subcategories: beak ice, double-horned ice, and rounded glaze ice. Rime and glaze ice have traditionally been defined by their shape, but a review of the icing processes and the data from this test show that glaze ice can indeed have a streamlined shape, especially when the airfoil has been oscillating. For cases when the droplets freeze on contact with the airfoil surface, air is trapped in the ice causing an opaque appearance. This is dry growth. Wet growth ice, where the water runs back along the airfoil or along existing ice, is clearer in appearance. Ice that has the attributes of both rime and glaze ice has been referred to as glime by some experimenters and mixed icing by others. Beak ice forms on the airfoil in the region of high negative static pressure at moderate to high angles of attack, and is the upper

portion of the more common double-horned shape (see also reference 8). These ice types are illustrated in figure 28. Oscillation tends to extend the chordwise ice coverage and to decrease the depth of the depression between the horns of double-horned ice. Figures 29 through 37 show ice tracings for many of the tested ice accretion cases.

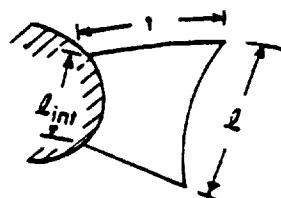
The NRC icing test data have been used to relate ice thickness to the ice height (separation distance between horns) for glaze ice and for the adhesion width (ℓ_{interior} or ℓ_{int}) at the airfoil surface. From figure 38, which shows data for five of the airfoils tested, the ice height is a function of the ice thickness and the "adhesion width for thickness equal to zero" (ℓ_{int_0}). From the curve fairings of figure 38, $\ell = t + \ell_{\text{int}_0}$

for the 9 to 12% thick airfoils and $\ell = 0.7 t + \ell_{\text{int}}$ for the 21% thick airfoil. The ice adhesion width, defined as the straight line distance between the base of the upper horn and the base of the lower horn, is a function of liquid water content, icing time (ice thickness), temperature, and airfoil shape. (The contact arc length is approximately 50% larger than the adhesion width for the airfoils and icing conditions considered.) Using the data fairings of figure 39, the adhesion width is equal to .2 times the thickness plus the "adhesion width for thickness equal to zero", i.e., $\ell_{\text{int}} = .2t + \ell_{\text{int}_0}$. Solving for ice height, one obtains the following relationships:

$$\ell = .8t + \ell_{\text{int}} \text{ for the 9 to 12% thick airfoils}$$

$$\ell = .5t + \ell_{\text{int}} \text{ for the 21% thick airfoil.}$$

These correspond to horn growth at angles of 23.6 and 14.5 degrees to the free stream velocity direction for these two groups of airfoils, respectively.



The boundary between ice types and for the onset of icing was determined experimentally during this test. The onset boundary was determined by slowly reducing tunnel temperature with the spray on. The first ice formed in the region of peak suction on the airfoil and was of the beak type. The beak ice zone, figure 40, can form when the stagnation temperature exceeds 0°C, because of the reduced kinetic heating and enhanced evaporation in the suction region. The variation in the temperature for the onset of icing as a function of angle of attack and droplet diameter is shown in figure 41. At low angles of attack beaks form on both the upper and lower surface, therefore appearing as double-horned ice. The temperature for the onset of icing is controlled by a complex energy balance. However, the onset of icing temperature can be approximated by first defining a corrected temperature:

$$T_c = \left[(T_s + 273.15) \times \left(1 + \frac{\gamma-1}{2} r M^2\right) + .33 (\alpha-6) \right] - 273.15 \quad (1)$$

where T_s is the static temperature, γ is the ratio of specific heats, r is a thermodynamic recovery factor, and M is the free-stream Mach number. The recovery factor had previously been suggested to be boundary layer recovery factor (reference 8). The static temperature for the onset of icing occurs when $T_c = 0$ degrees Celcius. When T_c is below zero degrees Celcius, ice can form on the airfoil. This test has shown the recovery factor to be dependent on both Mach number and LWC, as seen in figure 42. The recovery factor has been determined empirically to be represented by:

$$r = .0944 MW^2 + .385 MW + .98M^3 - 1.33M - .0283W^2 - .115W + 1.077$$

where M = Mach number
 W = Liquid water content (g/m^3) (2)

Applied against results obtained full-scale, in hover, at the NRC Helicopter Icing Spray Rig and for the helicopters flying in natural ice and behind the Helicopter Icing Spray System (HISS), the recovery factors derived in this test data correlate well. Figure 43 shows the hover correlation of observed and predicted ice extents the JUH-1H aircraft (from references 15 and 16). Figure 44 shows ice extent data acquired recently in level flight on a CH-53E helicopter (reference 17) and shows the improvement in correlation if it is assumed that the beak ice is too clear to be seen from a chase aircraft.

Force and Moment Data

Aerodynamic data were acquired for each model over a range of Mach number and angle of attack. Clean airfoil NRC data points acquired prior to ice accretion are shown in Appendix D. The data fairings are used as the base for icing lift, drag and pitching moment increments. Similar curves are presented in Appendix E for data from the OSU 6 x 22 wind tunnel tests, with and without simulated ice installed.

Figure 45 shows data that illustrate the lift increment at a constant angle of attack and the drag and moment increments at a constant lift coefficient (the lift coefficient of the iced airfoil) that result from ice accretion for increasing exposure times (τ). The increments vary with airfoil configuration. These changes can be explained by examining the wake momentum depression and the airfoil surface pressure distribution for several conditions. Figure 46 shows that the NACA 0012 model wake is much larger for the 45 and 60 second ice encounters. The growth of the upper surface boundary layer, while not separating, has increased the momentum loss and reduced the pressure recovery on the aft end of the airfoil. The pressure distribution changes slightly with 20 seconds of ice accretion, but the suction peak is reduced by 40% by 45 seconds of icing. The ice shapes that correspond to each icing time are given at the bottom of figure 46.

Figures 47 and 48 present similar information for the SC1095 and SSC-A09 airfoils, respectively. Each airfoil shows a smaller momentum loss due to ice and a better pressure recovery, producing a smaller drag penalty. Suction peak losses are also reduced, reducing the lift loss. These and other data from wet growth conditions are summarized in figures 47 to 51. For a constant Mach number and angle of attack, approximately linear relationships are observed for airfoil performance degradation as LWC increases, as seen in figures 49 and 50. The linear relationships may not hold if the conditions change so that the data crosses ice type boundaries. Ice thickness increases non-linearly. With Mach number and LWC constant, the airfoil performance degradation is non-linear with increasing angle of attack, as seen in figures 51 and 52. Noteworthy is the large rate of drag increase at higher angles of attack at Mach = .29. While the iced airfoil did not exhibit the characteristics of an early stall, the drag rise that normally accompanies stall did occur. Tunnel limitations precluded the acquisition of similar high angle of attack data at Mach = .58. The lift and pitching

moment increments for the thicker (12%) airfoils were smaller than those for the 9-9½% thick airfoils. However, the drag penalties tended to be greater for the thick airfoils, following the tendency of thicker airfoils to experience drag divergence at lower Mach numbers without ice. Substantial differences in behavior between airfoils are evident for variation in Mach number for constant liquid water content and angle of attack (see figure 53). Mach number had little effect on the drag increments for the thinner airfoils, but did have an impact on the NACA 0012 and VR-7 airfoils. Mach number had a greater impact on lift increments for the more cambered airfoils.

Several generalizations can be made from figures 49-53. First, the data from the OH-58 tail rotor blade stands apart from much of the other data. The drag and lift characteristics of the un-iced tail rotor are poorer than the NACA 0012 model. It was felt that this was due to the out-of-contour abrasion strip. However, fairing the aft edge of the abrasion strip did not reduce the drag and an explanation for the higher drag was not determined. Following an icing encounter, the drag and lift changes are small, giving significantly lower lift and drag increments for the tail rotor blade.

Droplet diameter effects were investigated for a limited number of conditions during this test. Figure 54 shows that changes in the median volumetric droplet diameter have little effect on the onset of ice temperature. This figure shows the changes in the droplet diameter result in small changes in the incremental lift and pitching moment coefficients. The drag increment trend is not clear from the test data. Predicted values for these parameters, based on methodology presented later in this report, is shown on this figure. The higher Mach number data may be affected by drag divergence, not considered in the development of the equations and normally not encountered for flight in icing conditions.

Selected icing conditions were repeated for the airfoil oscillating sinusoidally at a frequency of 5 Hz (typical 1/rev rotor frequency) with an amplitude of 9 degrees. The effect of oscillation on lift at a constant angle of attack (data taken after oscillation) was not discernable, but the drag was reduced when compared to ice accreted without oscillation. The effect of oscillation on pitching moment is small. The data that supports these oscillation conclusions are shown graphically in figure 55a.

Most of the cases considered above concern glaze ice conditions. Rime, higher temperature glaze, and beak ice shapes and resulting aerodynamic increments differ from the normal glaze results. For the more streamlined rime ice, the drag penalties are smaller. Table IV summarizes the tested characteristics of rime ice. (Predicted values will be discussed later in this report.)

The angle of attack was changed from the ice accretion angle for several test conditions. Figure 55b shows this data for five cases. The shaded symbols are the ice accretion angles of attack, and would fall on the line of zero error if there were no test data scatter or prediction tolerance. The prediction method, discussed later in this report, does not differentiate between the local and ice accretion angles of attack. Figure 55b shows that this assumption is valid at low angles of attack, but may introduce an error at high angles of attack.

For long icing times with rime ice conditions, the ice forms an insulation layer between the cold airfoil and the super-cooled droplets, and the droplets run-back prior to freezing, forming glaze ice. Therefore, an attempt to get larger incremental pure rime ice drag coefficients in the test by extending the icing time resulted in glaze ice and the correspondingly higher glaze ice incremental drag coefficients.

The drag increment is higher between the onset of icing temperature and a temperature 8 to 10°C below the onset temperature than it is at colder temperatures. Figure 56 shows the trend of C_d versus temperature. The surface of the ice is rougher and the ice horns form further aft on the airfoil. The increment in drag coefficient, used in equations (4) and (5), is approximated by the term:

$$.006 M^{2.4} \left[\frac{T_s - T_{glaze} + 8}{8} \right]^2 = .006 M^{2.4} K_D$$

for $(T_{glaze} - 8) < T_s < T_{glaze}$, where K_D is shown in figure 57, T_{glaze} is the boundary between beak and double-horned glaze ice, and the temperature boundaries are shown in figure 40.

ICING RELATIONSHIPS

The two-dimensional NRC wind tunnel data has been used to develop relationships for ice thickness and lift, drag and pitching moment increments. These correlations give improved prediction capability beyond that found in references 10 and 11. However,

continued comparison of predicted values with data is required to refine the relationships presented in this report to improve prediction accuracy further. The development of these relationships was based on knowledge of presumed important icing terms, primarily icing time, modified inertia parameter, liquid water content, temperature, airfoil thickness ratio, angle of attack, and airfoil leading edge radius of curvature. The lift, pitching moment, and drag increment relationships presented in the following paragraphs were developed in a multistep process. The NRC data were first evaluated assuming linear variance with liquid water content, icing time and the modified inertia parameter. This simplified approach fit limited data sets, but gave excessive scatter when applied to the complete NRC data set. Addition of leading edge radius and thickness to chord ratios, angle of attack and temperature, with empirically defined exponents and constants, improves the correlation. The effect of temperature is included in the relationships in several ways: (1) determination of ice type, (2) computation of atmospheric density, and (3) computation of empirically derived factors that account for temperature effects as the temperature approaches the onset of icing temperature. As the airfoil enters drag divergence or stall, the aerodynamic increments are very non-linear. The equations given below do not include terms to produce good results for those conditions.

Lift Increment Prediction

An incremental lift relationship, applicable for the full range of ice types tested, has been developed using the NRC wind tunnel data. The lift increment appears to be primarily a function of the modified inertia parameter, liquid water content, icing time, angle of attack, airfoil chord, airfoil thickness, and temperature. Using these terms, empirical constants were determined to fit the test data base, resulting in the following relationship:

$$\Delta C_L = \left[-.01335 K_o t/c (\alpha' + 2 + K_{L1}) .00555 (\alpha - 6)^2 K_L \right] \\ \times \left[w \left(\frac{c}{.1524} \right)^{.2} \tau_c / \left(\frac{c}{.1524} \right)^{1.2} \right] \quad (3)$$

where K_L and K_{L1} are functions of temperature and angle of attack as shown in figure 57 and τ_c is a corrected icing time which is defined and explained on page 23. The similitude (chord) terms

are based on reference 4, assuming these to be applicable to lift, drag, and pitching moment, as well as, accretion. Other terms follow normal definitions which are fully developed in Appendix F. Figure 58 shows the correlation of this relationship with NRC icing data, where ΔC_1 error is the measured ΔC_1 - predicted ΔC_1 . Table IV compares the measured and calculated lift increments for rime ice.

Drag Increment Prediction

Incremental rime ice drag is represented by a relationship that is similar in form to that of reference 10, but with the equation constants reduced, and with terms included to account for the observed effects of angle of attack and airfoil oscillation. Icing similitude effects are also included as discussed below. The relationship that applies for the rime ice zone is:

$$\Delta C_d = \left[.158 \ln \frac{k}{c} + 175 \frac{V}{\rho_I c} E W_{T_c} + 1.70 \right] \left[\frac{\alpha + 6}{10} \right] \times \left[1 - 8 \Delta C'_d \frac{V_{HELO}}{278} \right] \times \left[C_{d_{no \text{ ice}}} \right] \quad (4)$$

where

α is the mean angle of attack,

V_{HELO} is the helicopter forward flight speed,

$\Delta C'_d$ is the ΔC_d for $V_{HELO} = 0$ (i.e.: no oscillation effects).

and $C_{d_{no \text{ ice}}}$ is the clean airfoil drag

(if $C_{d_{no \text{ ice}}}$ is $> .0210$, use .0210 in eq. (4)).

The oscillation assumed for 278 mps (150 knots) has a frequency of 5 Hz and an amplitude of 9 degrees. Scaling multipliers for liquid water content and icing time used in Eqs. (3), (5) and (6) are omitted in Eq. (4). The rime ice drag increment is primarily Reynolds number dependent and the effect of chord is included in the skin friction and accumulation parameter ($VE/\rho_I c$) terms of equation (4). Table IV compares the rime rice drag increment

test data with predictions. For glaze and beak ice, the drag coefficient increment varies according to the variables of Eq. (3) as well as airfoil leading edge radius and Mach number. The constants of the glaze and beak ice drag equation have been determined empirically to fit the NRC wind tunnel data. The resulting glaze and beak ice drag increment is represented by:

$$\Delta C_d = K_{D1} \times \left[.00686 K_o \left(\frac{t}{c} \right)^{1.5} (\alpha + 6) - .0313 \left(\frac{r}{c} \right)^2 \right. \\ \left. + K_D \cdot 006 M^{2.4} \right] \times \left[W \left(\frac{c}{.1524} \right)^{.2} \tau_c / \left(\frac{c}{.1524} \right)^{1.2} \right] \\ \times \left[1 - 8 \Delta C_d' \frac{V_{HELO}}{278} \right] \quad (5)$$

where K_D and K_{D1} are functions of temperature as shown in figure 57. The rime equation and glaze equation are not necessarily continuous at the rime ice boundary. The drag within 2°C of this boundary is taken as the temperature weighted average of the rime and glaze drags for that temperature. This averaging is shown in Appendix F. Figure 59 shows the degree of correlation of these equations with the NRC test data. The SC1095 airfoil correlates well but the equations tend to underpredict the drag at high ΔC_d levels for the NACA 0012 and SSC-A09 airfoils. Two-dimensional correlation could, of course, be improved for the NACA 0012 and SSC-A09 airfoils by increasing the eq. (5) constant of .00686 to approximately .009. The rotorcraft power correlation, discussed later in this report, would also be improved using a larger constant. Correlation of data from other sources should be used to establish a constant that best represents the data from many test facilities.

Pitching Moment Increment Prediction

Incremental pitching moment is represented by an empirically-derived relationship applicable over the full range of tested ice types, using the variables of Eq. (5). This relationship is:

$$\Delta C_m = \left[(.00179 - .0045M) .000544 K_o \alpha / \left(\frac{t}{c} \right)^{2.7} \right]$$

$$+ .00383 M \left(1 - 63.29 \frac{r_c}{c}\right) \times \left[W \left(\frac{c}{.1524}\right)^{.2} \tau_c / \left(\frac{c}{.1524}\right)^{1.2} \right] \quad (6)$$

The correlation of this relationship with the NRC data is given in figure 60 and in Table IV.

Each of the above equations includes scaling terms based on information contained in reference 4 and supported by limited correlation for airfoils with chords greater than .1524 meters (6 inches) and by full scale rotorcraft correlation. (Further correlation with available test data should be pursued.)

Thickness Prediction

Ice thickness and shedding characteristics are difficult to predict and considerable empiricism is required. The model adapted in this study is a function of the rime and onset of ice boundaries and the amount of water that strikes the airfoil. This produces an accretion rate calculated according to the following relationship:

$$\text{Accretion rate } \dot{A} = f \beta_m W V \frac{t}{c} c/\rho_I \quad (7)$$

$$\text{where } f = \frac{T_s - T_{ON}}{T_R - T_{ON}}$$

The accretion rate is then used in one of three thickness equations. The first equation is used to compute the projection of beak ice. The beak ice is assumed to form in a simple triangular cross-section with the base length of 2% of the airfoil chord based on the average observed in this test. Using the equation for the area of a triangle results in:

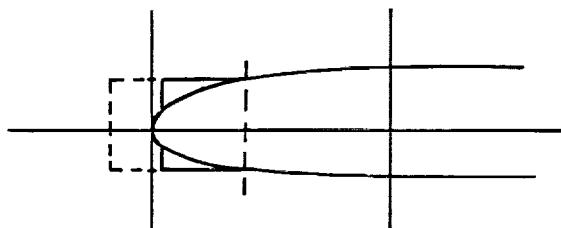
$$\dot{A} t_c = \frac{1}{2} (.02c) (t) (5f)$$

where the factor 5f is included to improve correlation with the experimental data. Solving for thickness results in:

$$t = 4A \tau_c / (.2cf) \quad (8)$$

The largest beak ice thickness observed in this test was 4 mm (.16 in.) or 2.7% of the airfoil chord.

The thickness of glaze and rime ice is a function of the airfoil contour. Glaze and rime ice can be modeled as a square edged block, growing forward from approximately 8% chord as shown in the sketch below.



Ice thickness can then be computed by calculating the chordwise length of a rectangle of area Δt with the leading edge area of the airfoil removed. To simplify these calculations, the leading edge area and thickness of .08 chord of any airfoil was assumed to vary linearly with thickness to chord ratio from that of the SC1095. Because of the two part nature of the ice growth, first ice grows forward along the airfoil surface leaving the stagnation region of the airfoil clear of ice. Then ice grows forward of the airfoil leading edge. A criteria index is computed and compared with the total accretion, Δt , to determine the extent of forward growth. For cases where ice grows forward of the leading edge,

$$\Delta t_c \geq [.7968 \frac{t}{c} (.08 + .00435/M) - .01854 \frac{t}{c}] c^2, \quad (9)$$

and ice thickness is then

$$t = (\Delta t_c + .01854 \frac{t}{c} c^2) / (.7968 \frac{t}{c} c) \quad (10)$$

The constants in these equations are derived from empirical fits of the SC1095 airfoil profile and generalized ice shape geometries.

When the relationship of Eq. (9) is not satisfied, ice has not formed at the airfoil stagnation point. The ice grows forward from the 8% chord location and the ice thickness is measured from the 8% chord point and is equal to

$$t = \frac{-B + \sqrt{B^2 + 4AAt_c t^2}}{2A (.095)} \quad \frac{t}{c} c e^{-3.067 f} \quad (11)$$

where A and B were determined empirically to be the following:

$$A = \frac{.01075}{M^2} - \frac{.1252}{M} + .473$$

$$B = \frac{.00248}{M^2} + \frac{.02108}{M} + .010$$

The correlation of predicted thickness with measured thickness is given in figure 61.

Shedding Prediction

Portions of the ice accreted will be lost due to self-shedding and sublimation. In the two-dimensional wind tunnel environment, pieces of ice that are part of the feathers and frost break away and new formations grow in their place. The icing times required to produce self-shedding occurred in the wind tunnel at temperatures within a few degrees of the freezing point. The quantity of ice required to produce self-shedding at colder temperatures caused excessive blockage in the NRC tunnel and resulted in non-uniform ice across the span of the model, precluding a more complete investigation of self-shedding effects. Self-shedding of large ice pieces has been observed during helicopter flight testing but, even in the absence of visible shedding, a reduction in the rate of torque rise has been measured as icing time increased. Figure 62 shows this reduction and also appears to indicate a self-shed of a larger ice piece at a time of about 210 seconds. Corrected time and centrifugal force terms have been included in the rotorcraft icing relationships to account for the self-shedding of larger ice pieces and less visible ice particles.

Reference 12 has been used as a pattern for the larger ice shedding model. The ice accretion model predicts ice mass and the

local centrifugal force is computed. The centrifugal force threshold for shedding on metal or fiberglass surfaces is set at a value of $-12 \times T$. In the rotorcraft prediction model, ice growth begins again on a blade element that has shed ice.

Even without large ice shedding the torque rise does not increase linearly with time as predicted from theory or as apparently shown for short (< 2 minute) icing times. There appears to be a maximum torque rise for a given rotor system for specified icing conditions. An effective or corrected icing time is produced by multiplying the actual exposure time by the term $1/e^{Kt}$. Correlation with data has suggested a $K = .00139$ [1/720 seconds]. This equation has a reversal for $Kt > 1$, and therefore, the corrected time for $Kt > .83$ is set to $260 + 114.6 \times (ln t - 6.397)$. The result is shown in figure 63.

Prediction Codes

The relationships included in this report have been programmed in FORTRAN subroutine form. Appendix F includes this subroutine, a test case input program, test case output, a flow diagram, and a sample hand calculation. The input, calculations, and output of this code are in standard international units. Appendix G shows the incorporation of rotorcraft variables in the code of Appendix F. A flow diagram, FORTRAN code, and a test case are presented.

The code checks the input conditions for conditions that exceed the onset of ice temperature on an airfoil and, if desired, the minimum temperature for icing according to three criteria (see reference 13). If icing will not occur, the output icing terms are set to zero. For conditions where icing can occur, atmospheric variables, modified inertia parameter and impingement efficiencies are calculated. Several empirical relationships are available to provide an estimate of maximum local collection efficiency and total collection efficiency. The equations employed in this report are based on curve fits of NACA data (reference 9). More general relationships developed from theoretical calculations can be found in reference 14.

The icing relationships for rime ice drag and glaze ice drag are not necessarily continuous across the rime ice boundary. Therefore, to avoid step changes in the drag coefficient, an averaging technique is used for static temperatures within 2°C of the rime ice boundary. Both rime ice and glaze ice drag coefficients are calculated for the input static temperature. The predicted coefficient within this band using the following relationship:

$$\Delta C_d = \Delta C_{d_{Rime}} + \frac{(\Delta C_{d_{Glaze}} - \Delta C_{d_{Rime}})(T_R - T_s - 2)}{4} \quad (12)$$

Comparison With Bragg and Gray Correlations

The correlations developed from the NRC wind tunnel data have been compared to the relationships developed by Bragg (reference 10) and Gray (reference 11). Bragg's rime ice fit gives higher drag coefficient increments than indicated by the NRC test data (see Table IV). Figure 64 shows a comparison of NASA data presented in reference 10 with both the rime ice correlations of this report and of Bragg's report.

The correlations of Gray (reference 11) were developed from limited data and do not contain terms to account for the variables found important during the analysis of the NRC test data. The lift increment correlation developed herein does not follow the $\Delta C_1/\Delta C_d$ form of reference 11. The lift increment relationship produced from NRC data base, which includes cambered airfoils, shows a lift loss due to ice at a zero angle of attack and less lift loss at higher angles of attack. The correlation of this report gives the following:

$$\frac{\Delta C_1}{\Delta C_d} = \frac{-0.01335 K_o \frac{t}{c} ((\alpha+2) + K_{L1} .00555(\alpha-6)^2 K_L)}{.00686 K_o (\frac{t}{c})^{1.5} (\alpha+6) + K_D .006M^2 - .0313 (\frac{r}{c})^2} \quad (13)$$

This result is compared with the reference 11 result in figure 65 for the NACA 0012 airfoil at Mach numbers of 0.29 and 0.49. (Note that since camber is not a variable in Eq. (13), the symmetrical NACA 0012 $\Delta C_1/\Delta C_d$ does not equal zero at an angle of attack of zero.)

A similar comparison has been made with the pitching movement curve presented in reference 11. The current data shows smaller pitching moment increment-drag increment ratios than reference 11, possibly because the current data shows generally higher drag increments than reference 11. In addition to that, the current work shows a significant Mach number effect on pitching movement that was not observed during prior tests due to the lower test Mach numbers. The correlation of this report in terms of the reference 11 ratio is:

$$\frac{dc_m}{dc_d} = \frac{(.00179 - .0045 M)(.000544 K_o \alpha \frac{1}{(t/c)^{2.7}}) + .00383 M (1-63.29 \frac{r}{c})}{.00686 K_o (\frac{t}{c})^{1.5} (\alpha+6) + K_D .006 M^2 - .0313 (\frac{r}{c})^2} \quad (14)$$

Many researchers, including the authors of references 11, 18 and 19, have recognized the shortcomings of the drag correlation of reference 11. While correlating well with the data base available to Gray in 1957, significant scatter on both the high and low side of the correlation exists when compared with recent NASA data (reference 10) and the recent NRC data presented herein. In addition to accuracy problems using the Gray correlation, the portion of the high Mach number data where the total temperature exceeds 0°C (32°F) must be discarded since the Gray relationship cannot be solved for those high total temperatures. Figure 66a shows the error for the Gray correlation versus the measured drag coefficient increment for the NACA 0012 airfoil. Figure 66a shows the correlation in a form for comparison with figure 59a, showing the improvement achieved with the relationships of this report.

Figures 66b-66d present the reference 11 predicted drag increments, compared to the NRC data for the NACA 0012, SC1095 and SSC-A09 airfoil, respectively. The data is presented in this format, rather than the figure 59 format, to show clearly the problem of limiting the maximum allowable total temperature to 32°F, as Gray does in the reference 11 correlation. Figures 66b and 66c each show many points where the Gray drag increment has been set to zero because the test total temperature exceeded 32°F. Use of the corrected temperature as defined earlier in this report, instead of total temperature, overcomes the problem of the equation icing temperature exceeding 0°C (32°F), but overall correlation is not improved (see figure 66e).

Correlation With Rotorcraft Data

The two-dimensional icing code was adopted for use as a subroutine to Sikorsky Aircraft hover (the Circulation Controlled Hover Analysis Program) and level flight (Generalized Rotor Performance) codes. The subroutine, a test case, and the code to run the test case are listed in Appendix G. Differences in performance codes will necessitate adaptation in each case, but the computation of icing quantities should be unaffected. The following paragraphs describe differences between 2-D and rotor

icing equations; refer to the text describing the 2-D code for basic information. Since most performance codes are written using the British system of units, geometric and flight condition inputs are in that system. Output is also in the British system except as noted.

Forward flight creates a non-uniform flight condition for each blade station. Based on observed ice shapes and ice extents, the existence and type of ice is based on the average blade segment velocity and angle of attack. Calculation of the lift and drag increments are based on local conditions. Flight test data indicates that tip sweep does not affect the icing process (see figure 67). There is no discernable change in the ice formation that would accompany the reduction in local tip Mach number due to the tip sweep of 35 degrees.

While the rotor codes utilized 36 azimuthal positions with 15 blade segments, the blade segments are large enough to introduce errors in the prediction of the drag increment due to the dependence of this increment on corrected temperature. Therefore, the drag increment is calculated at the segment boundaries as well as at the normal aerodynamic calculation station. These values are averaged for use in the calculation of performance.

Shedding of ice pieces will occur when the centrifugal force exceeds the bond strength between the airfoil surface and the ice. A shedding criteria of -12 lb/sq. ft. times the corrected temperature has provided good correlation with existing flight test data for metal and fiberglass blade surfaces. This relationship gives a zero bond force at a zero corrected temperature (see reference 12). The program computes the time to a blade shed, reduces the icing time, and restarts the icing process.

The program is arranged to permit the calculation of either ΔC_l or ΔC_d to reduce computation time for programs that include separate lift and drag iterations within the major iteration. The variable ISWITC is set in the host program to control this option. Calculation of ΔC_m can be added to this subroutine for use in flexible-blade programs using the form of the equation for DELCM in Appendix F.

The rotorcraft icing code has been used to compute hover torque rise for S-76A and JUH-1H hover artificial icing data and level flight torque rise for UH-60A and S-76A artificial and natural icing data. Key to the success of a prediction method is the determination of ice extent and the type of ice that forms on the blade. Figures 43 and 44 show that the methods developed herein

predict the onset of ice and, therefore, ice extent well. However, there are instances of rotorcraft ice existing above the boundary predicted using the NRC two-dimensional data, especially at the lower Mach numbers (see figure 43). The importance in determining the onset of icing and providing an accurate measure of temperature is illustrated by the sensitivity of the power-temperature relationship given in figure 68a. For the warmer ice conditions ($T_s > -20^\circ\text{C}$) the predicted UH-1H torque rise increases by nearly 2% for each 1°C reduction in temperature, and the ice extent increases 4% for each 1°C reduction in temperature. An error in predicting the onset of ice temperature or in measuring temperature during flight testing, when combined with potential errors in measurement of liquid water content, can produce large errors in the predicted torque rise. For example, an S-76A icing flight condition at $\text{LWC} = 0.25 \text{ g/m}^3$ and an ambient temperature of -4°C had a predicted torque rise of 1%. However, if the conditions in reality were an LWC of 0.50 g/m^3 at a temperature of -6°C , the predicted torque rise increases to 8%. At cold temperatures, the measurement of temperature is less critical, but an error in measuring LWC of 0.3 g/m^3 could give a change in predicted torque rise of 6% (see figure 68a). The correlation of predicted and measured torque rise for hover conditions is shown in figure 68b. Much of the scatter can be attributed to variability within the flight test data set. However, part of the deviation contained in figure 68b is temperature related. The cases where the observed torque rise exceeds the predicted torque rise are generally for warmer temperatures. For these cases, the prediction method of Appendix G appears to underpredict the ice extent. The cases where the observed torque rise is less than the predicted torque rise, the temperatures were colder and the prediction method appears to overpredict ice extent. Additional data should be compared to the prediction method, and if the correlation errors of figure 68b exist for other tests, constants of equations 1 and 2 should be modified. Modification of the constant of .0068 to .0090 in eq. 5 improves the correlation of the warmer temperature points in figure 68b by about 2% at an observed torque rise of 10%.

Research quality level flight data in icing is not abundant. Torque data acquisition flying behind the JCH-47C Helicopter Icing Spray System (HISS) is not practical because of wake turbulence, and the measurement of liquid water content in natural icing is not as reliable as required for accurate correlation work. Recent icing research tests using the U.S. Army JUH-1H and the RAF Chinook HC1 helicopters may provide some of the needed research-quality flight test data. Figure 68c shows the torque correlation in level flight. The level flight data

are for warmer temperatures and, as shown for the hover condition, the observed torque rise exceeds the predicted torque rise. Level flight icing data at cold temperatures must be compared with the prediction to determine the validity of prediction at the colder temperatures.

Figures 67 and 69 show ice shape photographs for the S-76A rotor following icing in the NRC Icing Spray Rig. The glaze ice at the top of figure 69 is easy to see and would be visible from a chase aircraft observing the icing process. The beak ice shown in the lower part of figure 69 is clear, shows evidence of shedding, and would be difficult to see from chase aircraft. Photographic data have been used to produce the shape data of figure 70. Figure 70a shows that the predicted ice thicknesses agree well with S-76A observed thicknesses. The first two parts of this figure shows the predicted ice shedding characteristics. Figure 70b shows that the prediction overpredicts the ice thicknesses measured on the JUH-1H helicopter. Shedding is predicted for each of these test conditions.

OSU AND NRC SIMULATED ICE TEST RESULTS

Tests of airfoils with simulated ice in the OSU 6 x 22 tunnel were included in this program for comparison with the NRC icing data. Since the force and moment increments between the artificial tunnel icing and the simulated ice differed, additional simulated ice testing was done during the second NRC test. Appendix E presents plotted force and moment data for each of the castings for ranges of Mach number and angle of attack. The results are summarized for four of the castings in figures 71 through 74. Figure 71 is for a small piece of ice (see Table I for conditions) on an NACA 0012 airfoil. The lift increments for artificial and real ice are similar. The drag increment differences are significant, ranging from a difference of .0035 at low lifts to over .0080 at high lift. The pitching moment slopes are comparable. For a larger ice accretion, figure 72, and different airfoils, figures 73 and 74, the trends are similar. Figure 75 summarizes the force and moment increment differences for each of the ice castings. This figure shows that the ice casting data compares well for the lift and pitching moment increments. Drag is lower for the castings for angles of attack and Mach numbers that are below stall and the drag divergence Mach number.

During the simulated ice testing at the Ohio State University, it became apparent that the drag of the simulated ice was less than the NRC artificial ice for most conditions. Figure 76 illu-

strates the observed differences, showing lower ice drag increments for the castings and lower drag for simulated ice in the OSU wind tunnel at pre-stall conditions and higher simulated ice drags at high lift coefficients. The high lift discrepancy is due to the relatively large model size in the NRC tunnel, which prevents normal stall on the 15.24 cm models. The 6.83 cm model had normal stall behavior. Testing dedicated to isolate the important parameters affecting the drag was conducted at OSU, and later at NRC. Several reasons for the differences were postulated and then systematically researched to determine the impact of that parameter. The items considered included:

1. Reynolds number
2. Roughness of simulated ice
3. Effect of differences in drag probe position and traversing rate
4. Effect of rime feathers
5. Effect of part span ice
6. Effect of additional tunnel running time after icing
7. Tunnel turbulence

The effect of Reynolds number was investigated using a simple representation of an ice shape from the reference 16 testing (test condition "E"). Figure 77 shows that the drag increases for each of the three airfoil configurations tested, but not by an amount that would fully explain the observed differences. Grit was added to several configurations to determine the sensitivity to roughness. The grit had a large impact on the clean airfoil at low Reynolds numbers (see figure 78), but had a lesser impact for models with simulated ice and at higher Reynolds numbers. Roughness and Reynolds number increments are not of a magnitude to explain the observed differences between artificial and simulated ice. Tunnel turbulence (see figure 21) in the NRC tunnel is believed acceptable for aerodynamic work even though it is higher than good aerodynamic tunnels. The impact of turbulence should be similar to Reynolds number effects.

Two simulated ice models were selected for further experimentation. One of these experienced a large ice-to-casting drag error and the other a relatively small error. For most of the cases where ice castings were to be made, additional data were acquired at other angles of attack for comparison with data from the OSU simulated ice test. This, of course, required additional tunnel running time to acquire this data, similar to the added time required to obtain steady performance data after an icing encounter behind the HISS tanker or in the NRC Icing Spray Rig.

Maintaining the same Mach number and angle of attack, data was taken periodically after the icing encounter to determine the change in drag. The case with the small ice-to-casting error, which was a low angle of attack case, the change in drag was small. For a six degree angle of attack the change was significant (see figure 79) and is believed to account for about half the artificial ice to simulated ice drag difference. Tests were also conducted in the same manner to determine the effect of angle of attack changes and the effect of a tunnel shutdown. Neither effect is significant.

Changes in drag probe head-to-airfoil trailing edge position and the rate of traverse of the drag probe had a negligible effect of the drag coefficient.

The effect of the rime feathers on drag was shown in this test to be significant, contrary to results expressed by some experimenters. Figure 80 shows drag coefficient reductions of up to .013 when the feathers were removed and the main glaze ice section retested. The bonding of portions of the simulated ice feather to the airfoil is not practical, even though the casting process does reproduce the feather pieces. The effect of part span ice in the NRC tunnel ranged from a drag increment of .007 (as shown in figure 80) to values that are insignificant.

Testing of models of ice from JUH-1H test "E" (reference 16) shows that similar models of simulated ice at the same Reynolds number produces the same lift-drag polar (see figure 81). A third model of this ice, but with rounded corners, is shown here to illustrate the need to model the ice properly to obtain more realistic drag levels.

CONCLUSIONS

Testing in the NRC High Speed Icing Wind Tunnel and the OSU Transonic Airfoil Facility have expanded the data base on iced airfoil performance. Systematic variations of environmental and tunnel conditions has yielded trends for the impact of these parameters on iced airfoil performance. The influence of airfoil shape on icing was observed among the ten airfoils tested.

The measurement of lift using the difference between upper and lower plenum pressures was successful and can provide lift coefficient information for airfoils without pressure orifices, and for cases where orifices are blocked by ice. Several ice shapes were successfully molded using a silicone rubber material. The molds were used to fabricate ice castings for follow-on testing in the OSU and NRC wind tunnels.

Leading edge ice increases the momentum loss in the wake and reduces the pressure recovery at the trailing edge, increasing airfoil drag. At lifting conditions the suction peak is reduced, providing less lift at a constant angle of attack. Generally, lift and drag increments vary linearly with liquid water content and icing time. Increasing Mach number has a greater impact on the 12% thick airfoils than for the 9% thick airfoils.

The data has been generalized into a series of equations, providing a prediction of ice thickness and force and moment coefficients with an accuracy of about 30%. The relationships have been incorporated into rotorcraft performance codes to give ice extent and torque rise information. An assessment of the accuracy of the torque prediction method is difficult because of the observed scatter in the helicopter performance flight test data. The prediction of trends of rotorcraft ice extent, ice thickness and torque rise is good, but further correlation is needed to validate the relationships for the prediction of absolute values. Simulated ice testing provides a good means of determining icing trends. The simulated ice produces lift and pitching moment increments that agree well with icing data. The drag with simulated ice tends to give lower drag increments than the icing data.

RECOMMENDATIONS

Research in the field of rotorcraft icing is progressing more rapidly at this time than during any other time period. It is apparent, however, that data to provide correlation information, especially rotor icing data, is lacking in detail and completeness. Recent NASA/Army flight research is providing quality data and the procedures adopted for that research should be extended to qualification test programs to augment the rotorcraft data base with complete, high quality ice characterization and performance information, for both full scale and model scale rotors. The methodology presented in this report should be compared with rotor data and airfoil data taken in other icing and simulated ice tests to substantiate and improve the prediction accuracy.

It is recommended that the following work be conducted to augment the conclusions made in this report:

- (1) Conduct additional analyses of the data contained in this report, especially the comparison of artificial icing and simulated ice.
- (2) Compare the results of the icing prediction methodology presented herein with airfoil icing data from other facilities, using airfoil chord differences to substantiate scaling laws.

- (3) Conduct model and full scale icing research tests to evaluate artificial icing techniques (versus natural icing results) to study shedding and scaling effects and to improve prediction methodology.
- (4) Compare the results of model and full scale rotor tests with the prediction method. Study the ice accretion and shedding characteristics to provide a better understanding of these effects.
- (5) Validate the methodology contained herein (or an updated method) so that it will be accepted as a means to reduce the cost of rotorcraft icing qualification and certification.
- (6) Empirical terms, required in the equations presented in this report, should be studied further and replaced with more physically-based terms.

TABLE IICE MOLD/CAST ICE CONDITIONS

<u>NRC, PHASE I</u>	Mach Number	Angle of Attack, deg	Airfoil	Mold Number	OSU Config. Number	Run Number	LWC g/m ³	Icing Time, Sec	Total Temp, °C	Oscillation
0.29	3.0		SC1012 R8	1	18	1086	0.66	60	- 5.0	No
0.38	6.0		SC1012 R8	2	19	1314	1.14	60	-10.0	Yes
0.38	6.0		SC1094 R8	1	15	1309	0.62	60	-10.0	Yes
0.39	5.6		NACA 0012	2	3,221	561	0.48	60	-10.0	Yes
0.40	6.0		NACA 0012	1	2	453	0.30	60	-10.0	Yes
0.47	6.0		SC1094 R8	2	16	1363	1.06	60	-10.0	Yes
0.48	6.0		SC1095	1	6	261	0.30	60	- 5.0	No
0.57	0.0		SSC-A09	2	10 ²	1088	0.58	45	-10.0	Yes
0.58	3.0		VR-7	1	12	784	0.50	60	-10.0	Yes
0.59	3.0		VR-7	2	13	936	0.50	60	-10.0	No
0.59	3.0		NACA 0012	3	4	1153	0.58	45	-10.0	No
0.59	3.1		SC1095	2	7	754	0.50	45	-10.0	Yes
0.59	6.0		SSC-A09	1	9	931	0.85	45	-10.0	No
0.69	0.0		OH-58 TR	1	21	1188	0.64	38	-10.0	No

TABLE I (Cont'd)

<u>NRC, Phase II</u>	Mach Number	Angle of Attack, deg	Airfoil	Mold Number	OSU Config. Number	Run Number	LWC g/m ³	Icing Time, Sec	Total Temp, °C	Oscillation
0.39	6.0		NACA 0012	4	-3	2106	0.48	60	-10.0	No
0.39	6.0		SSC-A09	3	-4	2162	0.48	60	-10.0	No
-	-		NACA 0012	5	-5	-	0.70	6	7	No

1 NRC Configuration Number 9

2 NRC Configuration Number 10

3 NRC Configuration Number 13 (Configuration 14 with lower surface feathers removed, 16 with casting trimmed to 6" span).

4 NRC Configuration Number 15

5 NRC Configuration Number 11 (Wood ice, scaled ice from Flight E, BS=126 of reference 14)

6 Full scale time of 180 seconds, model scale time of 48 seconds.

7 Static temperature of -19.0°C

TABLE II
ERROR ANALYSIS

<u>WIND TUNNEL TEST MEASUREMENT ERRORS - ESTIMATED</u>		<u>Est. Maximum Deviation From Target Value</u>
Mach Number		0.05
Angle of Attack, Degrees		0.1
Liquid Water Content, g/m ³		0.1
Mean Volumetric Droplet Size, μm		2
Tunnel Total Temperature, °C		0.7
<u>FLIGHT TEST MEASUREMENT ERRORS (TYPICAL)</u>		
Velocity m/s (knots)		0.9 (1.8)
Rate of Climb, m/s (fps)		0.3 (1.0)
Torque, %		2.0
Tip Speed, %		0.2
Liquid Water Content, g/m ³		0.15
Mean Volumetric Droplet Size, μm		4
Outside Air Temperature, °C		0.7

TABLE IIIERROR ANALYSISAERODYNAMIC COEFFICIENTS AND ICE THICKNESS

Reference Conditions: NACA 0012 Airfoil in NRC Tunnel
 $M = 0.38$, $\alpha = 6.0$ deg.

Parameter	Clean Airfoil		Iced Airfoil	
	Maximum Deviation From Mean Value	One σ Deviation	Maximum Deviation From Mean Value	One σ Deviation
$C_1 = .73$, $C_d = .0125$, $C_m = -.002$			$C_1 = .62$, $C_d = .0430$, $C_m = .003$	
Lift Coefficient - Pressure Plenum $C_p @ x/c = 40\%$.034 .043 .049	.018 .030 .021	.038 .040 .078	.020 .024 .041
Drag Coefficient - Momentum	.0011	.0006	.0066	.0035
Pitching Moment Coefficient - Pressure	.005	.002	.003	.002
Ice Thickness, mm(in.)	-	-	1.0 (.04)	-

ORIGINAL PAGE IS
OF POOR QUALITY

TABLE IV
RIME ICE AIRFOIL THICKNESS AND PERFORMANCE INCREMENTS
(See Appendix A or C for further detail of test conditions)

Airfoil	Run No.	LWC	Mach No.	T_s (°C)	α (Deg)	Thickness (mm)	ΔC_1		ΔC_m		ΔC_d		Ref. 10		
							Test	Predicted	Test	Predicted	Test	Predicted	1		
NACA 0012	407	.35	.29	-9	0	1.5	2.9	-.03	-.01	.013	0	.016	.012	.008 .021	
	408			-14		2.3	3.5	-.02	-.01	.003	0	.011	.008	-.021	
	410					2.3	3.5	-.03	-.01	.008	0	.016	.008	-.021	
	529	.16	.68	-32	3	4.8	4.4	.02	-.01	-.001	0	-.018	-.018	.029	
	580	.66	.29	-14	6	7.1	5.1	-.01	-.05	0	.002	.021	.025	.019 .033	
	2077	.30	.29			3.3	3.0	-.17	-.04	-.005	.002	.021	.018	-.023	
	2256	.38	.18			16.0	11.9	-.19	-.14	-.026	.001	.018	.039	-.123	
	426	.66	.29	-14	0	2.3	3.5	-.01	-.02	.002	.002	.015	.016	.014	
	430	.35				3	1.3	2.4	-.03	-.02	-.005	.003	.013	.012	-.023
	440		.30			6	1.5	2.4	-.10	-.03	0	.005	.016	.019	-.026
SC1095	612	.16	.68	-32	0	4.1	5.5	.02	0	.001	.001	.005	.010	.024	
	653	.66	.29	-14	9	3.3	3.5	-.20	-.08	.001	.014	-.041	.058	.062	
	666	.66	.29			3.3	3.5	-.20	-.08	-.005	.014	.036	.041	.057	
	682					6	4.1	3.6	-.09	-.06	-.002	.010	.028	.031	.036 .049
	684	.36	.49	-22		-	3.8	-.08	-.04	-.010	-.003	.011	.033	.037 .049	
	686	.66	.29	-14	3	4.1	3.6	0	-.04	0	-.006	.012	.022	.018 .032	
	728	1.06	.31	-20	6	4.1	4.1	-.06	-.09	-.020	.011	.020	.037	.034 .046	

1 Appendix E Methodology

2 Rime Equation Only

TABLE VROTORCRAFT CORRELATION IN HOVER

Aircraft	Flight	Gross Wt. (kg)	Wind (mps)	Altitude (m)	Static Temp (°C)	LWC (g/m³)	D _d (μm)	Time (sec)	Obs. (%)	Pred. (%)	Max Thickness Obs. (mm)	Pred. (mm)	Torque Rise Pred. (%)	Torque Rise Obs. (%)
UH-1H	A	3500	4	0	-12	.40	.30	270	75	80	6	12	10	5
	B	3210	5	0	-9.5	.40	.30	265	65	65	9	9	5	3
	C	3450	3	0	-17.5	.40	.30	240	85	96	-	-	5	14
	D	3480	2	0	-21.5	.40	.30	360	92	99	8	26	6	18
	E	3200	5	0	-19	.70	.30	180	72	74	12	20	9	18

TABLE VIROTORCRAFT CORRELATION IN FORWARD FLIGHT

Aircraft	Flight	Gross Wt. (kg)	TAS (m/s)	Altitude (m)	Static Temp (°C)	LWC (g/m³)	D _d (μm)	Time (s)	Time	Torque Rise Pred. (%)	Torque Rise Obs. (%)
UH-60A	76-2	7080	46	690	-11	.25	.25	30	300	6	4
	76-3	7120	46	1230	-5.5	.25	.30	600	600	2	1
	76-15	6890	46	990	-12	.50	.30	240	240	20	6
	76-17	6890	45	580	-11	.50	.30	2040	2040	20	6
	80-6	7510	62	1220	-7.5	.24	.24	200	200	14	1
	80-25	7280	71	1040	-5	.29	.20	248	248	4	1
	80-26	7310	58	1400	-7.5	.24	.20	163	163	12	2
	82-3	7380	59	950	-7	.42	.20	5100	5100	7	2
	82-6	7380	64	900	-6	.30	.12	3540	3540	8	1
	82-7	7230	60	1760	-1.5	.20	.9	2640	2640	9	4
	82-8	7470	58	2040	-4	.50	.19	2580	2580	18	0

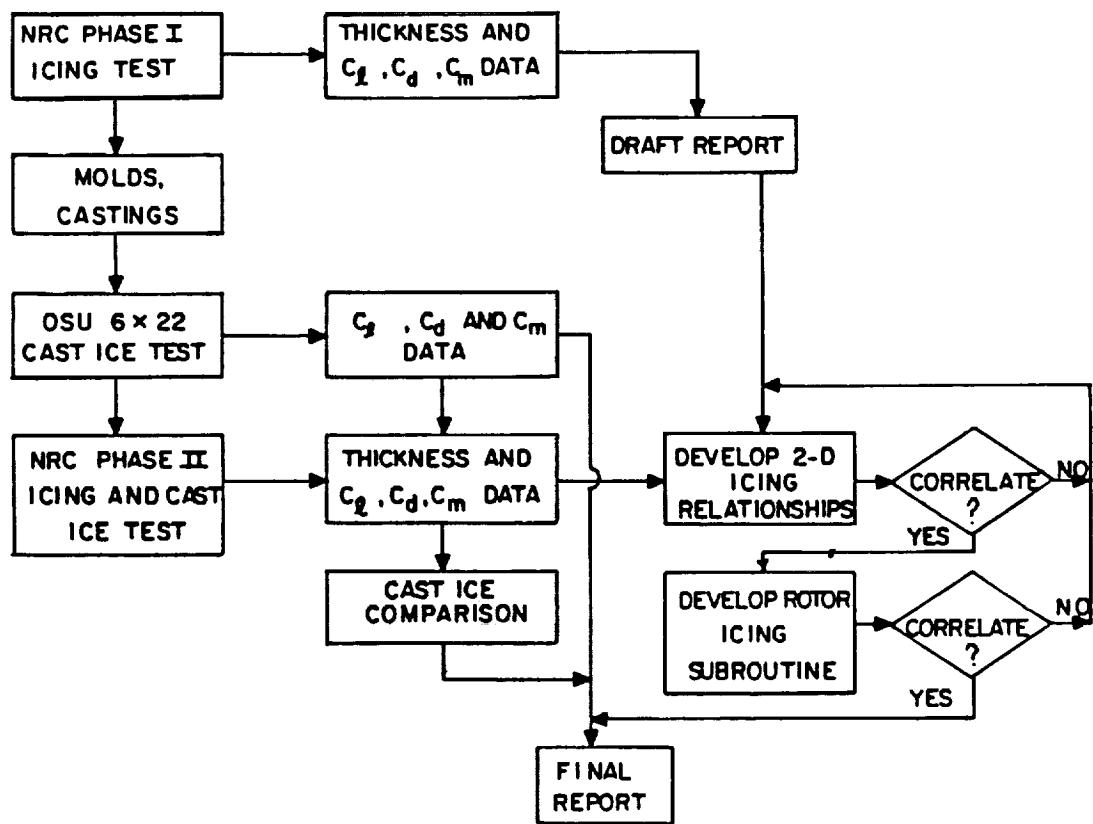


Figure 1. - High Speed Ice Accretion Program.

ORIGINAL PAGE IS
OF POOR QUALITY

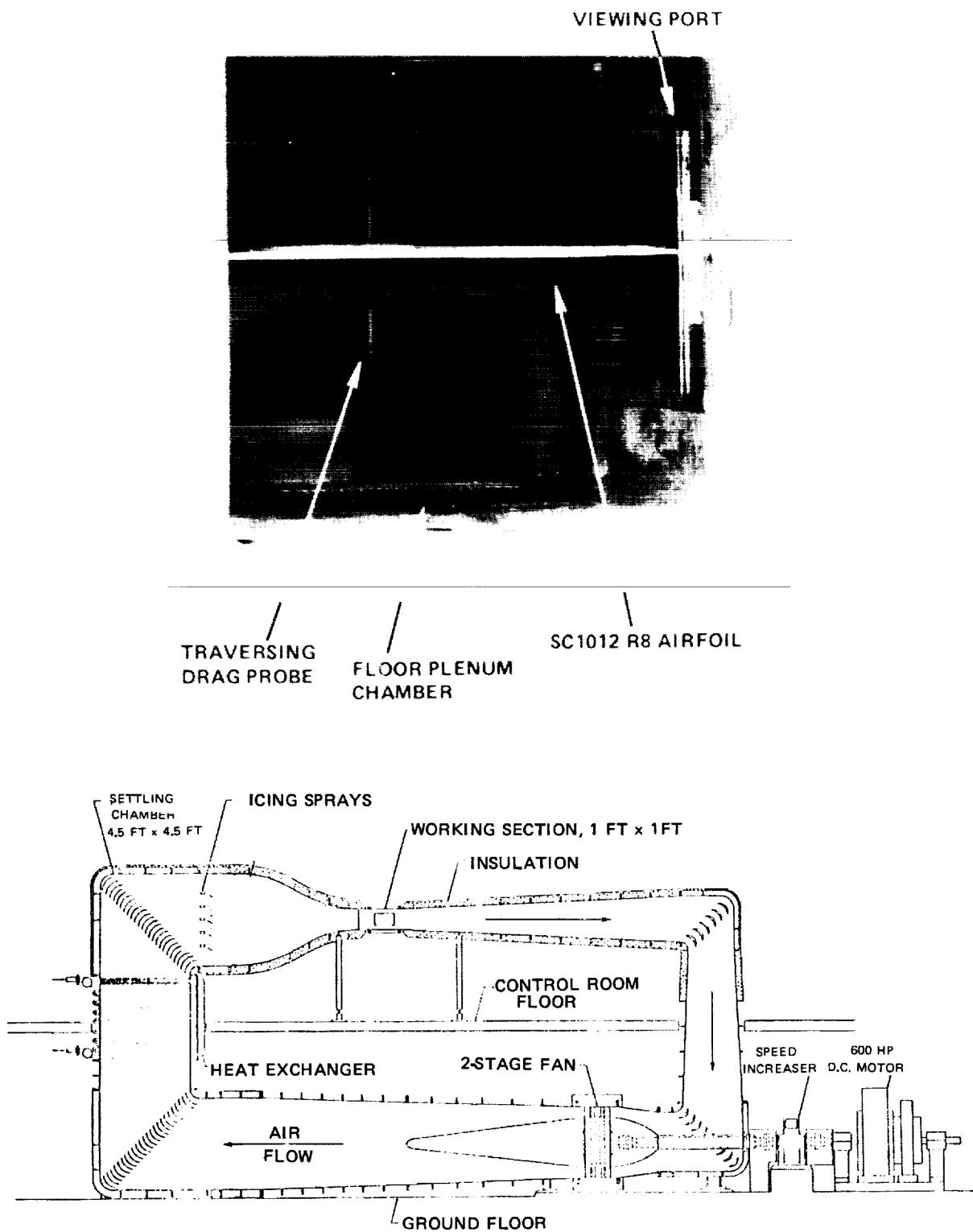


Figure 2. - NRC High Speed Icing Wind Tunnel.

ORIGINAL PAGE IS
OF POOR QUALITY.

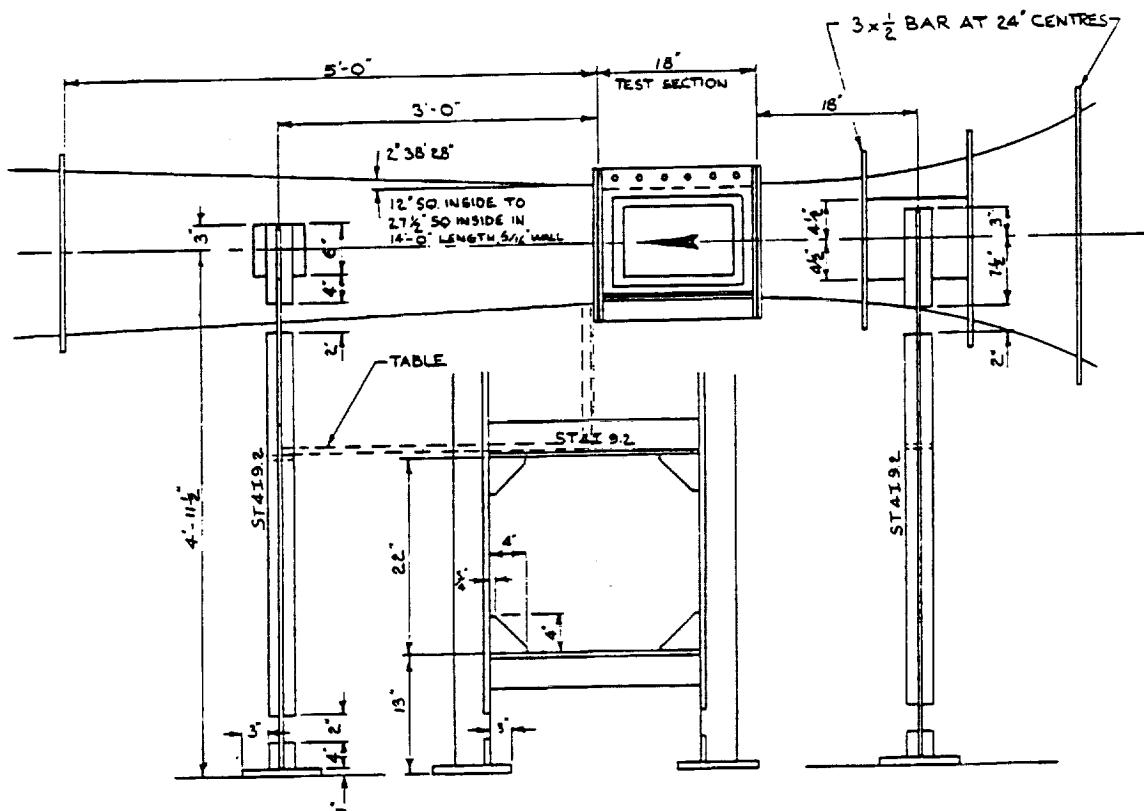


Figure 3. - Test section drawing-NRC High Speed Icing Wind Tunnel.

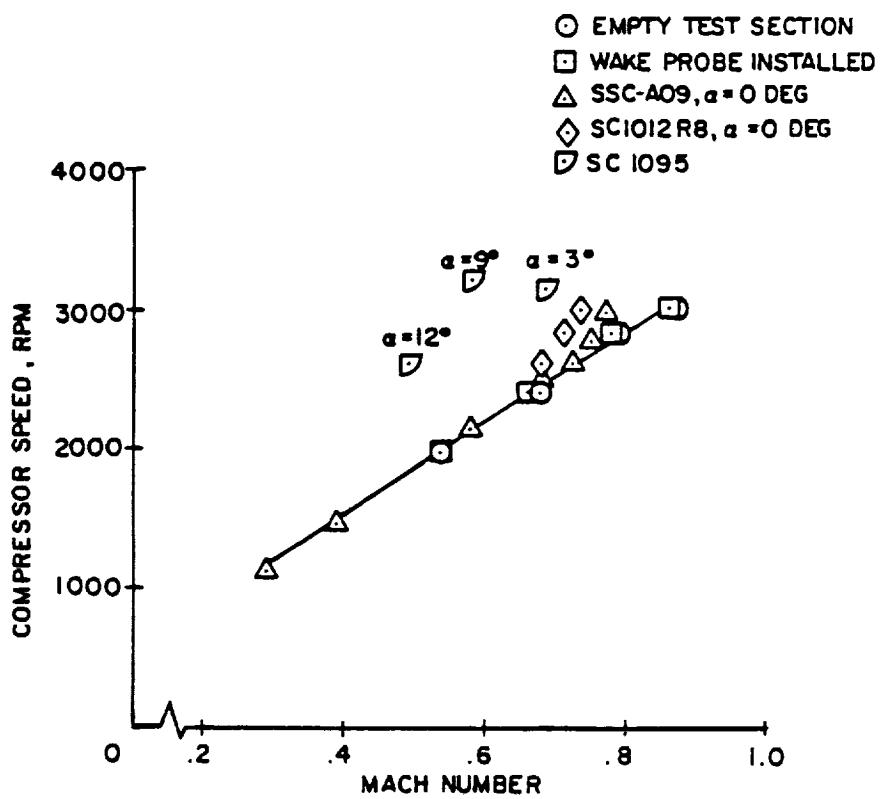


Figure 4. - Drive system speed versus Mach number.

ORIGINAL PAGE IS
OF POOR QUALITY

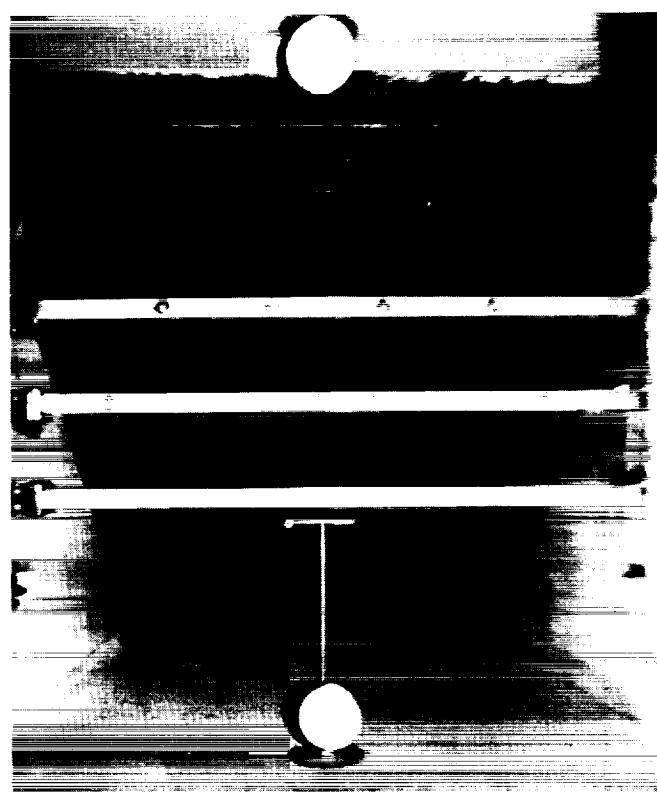


Figure 5. - Icing spray bars.

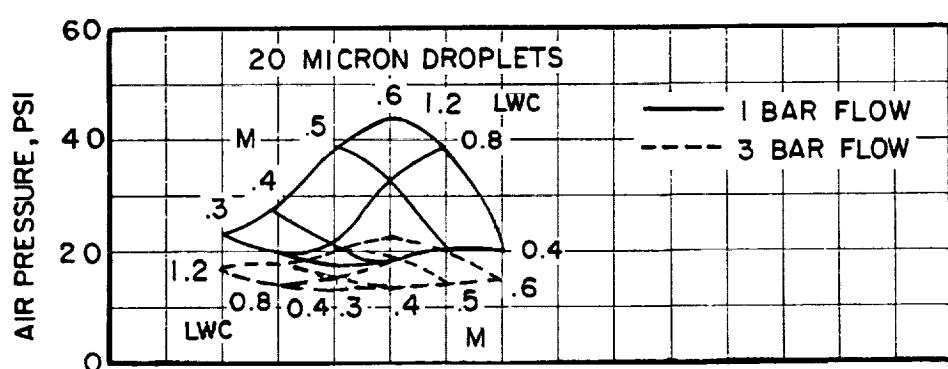
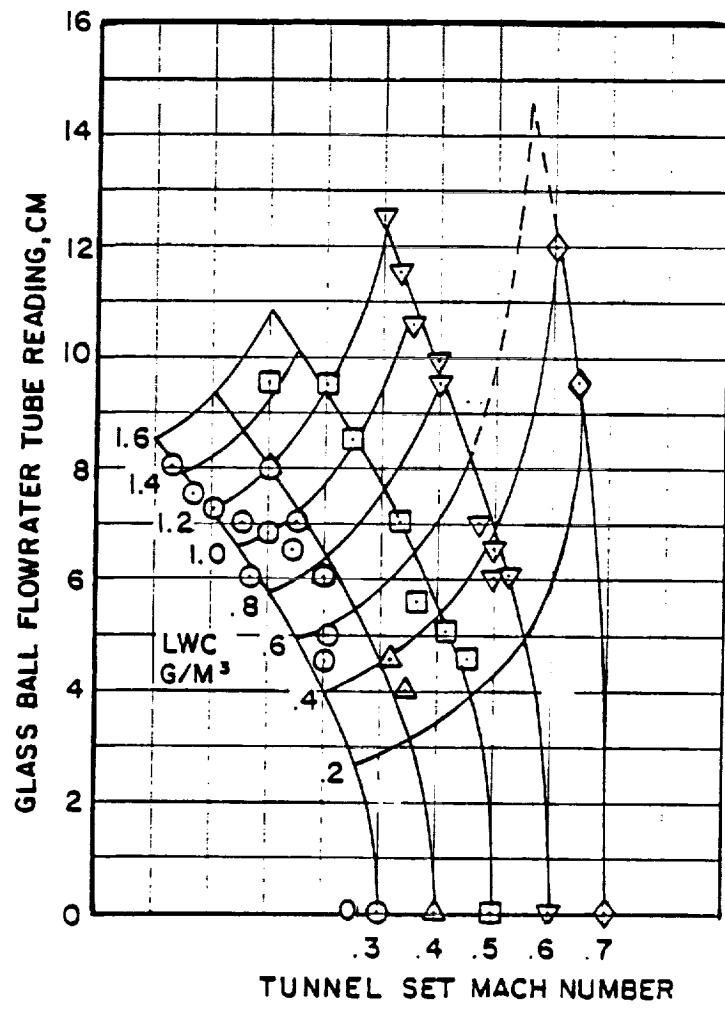


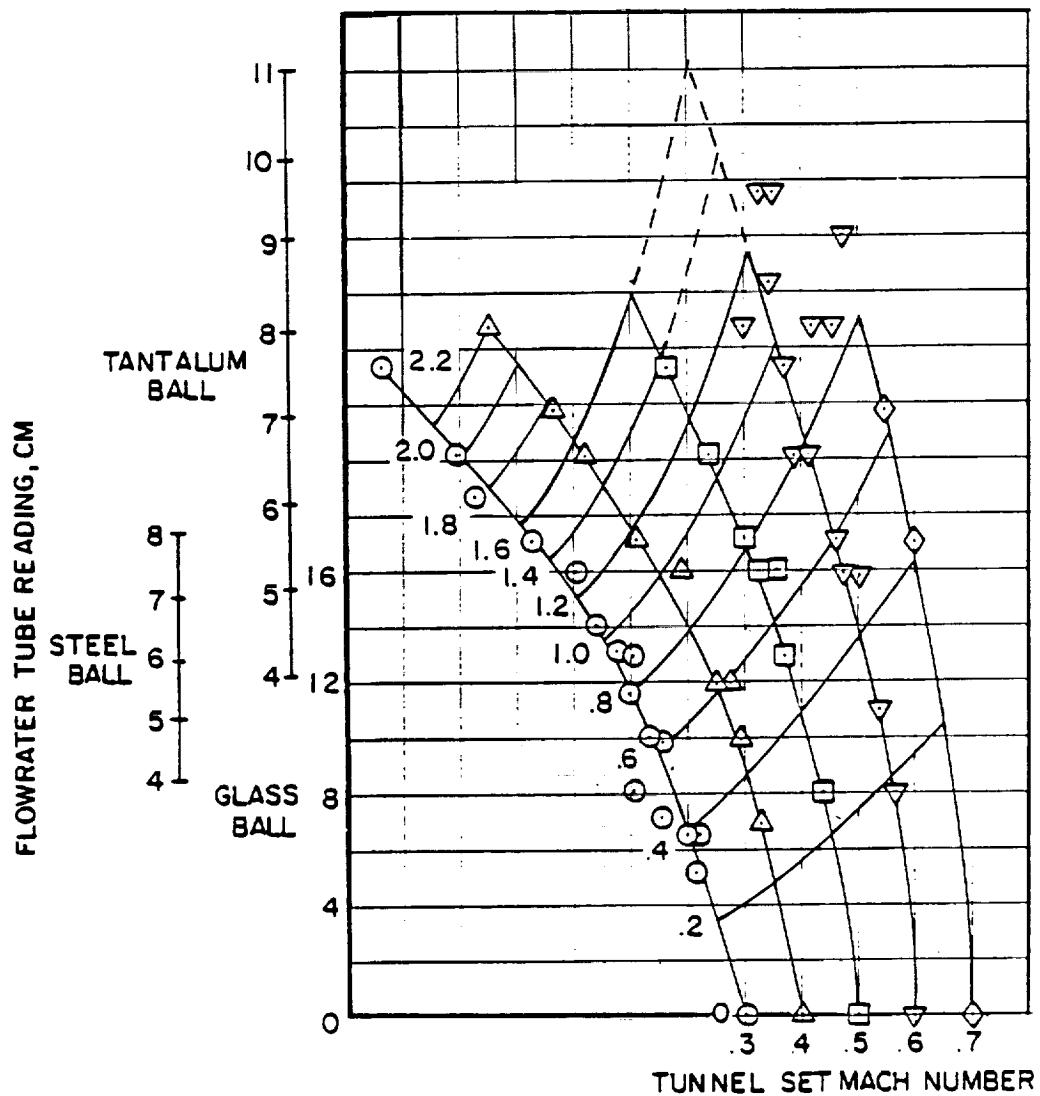
Figure 6. - Spray bar air pressure.



a. Three spray bars.

Figure 7. - Liquid water content calibration.

ORIGINAL PAGE IS
OF POOR QUALITY



b. One spray bar

Figure 7. - Concluded

ORIGINAL PAGE IS
OF POOR QUALITY

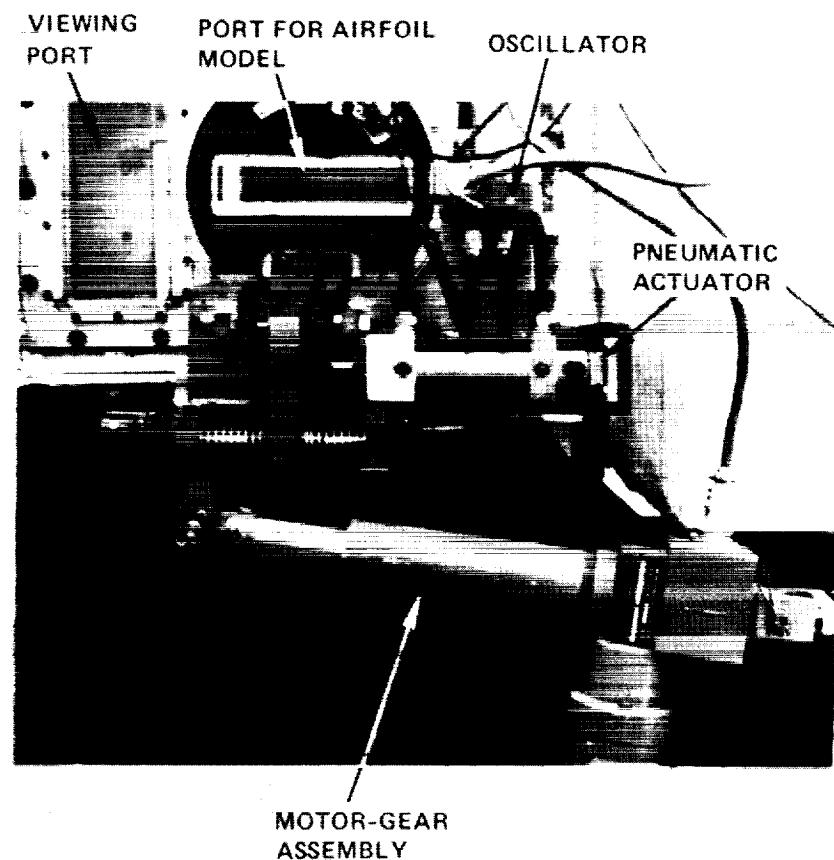


Figure 8. - Airfoil support and control apparatus in the NRC High Speed Icing Wind Tunnel.

ORIGINAL PAGE IS
OF POOR QUALITY

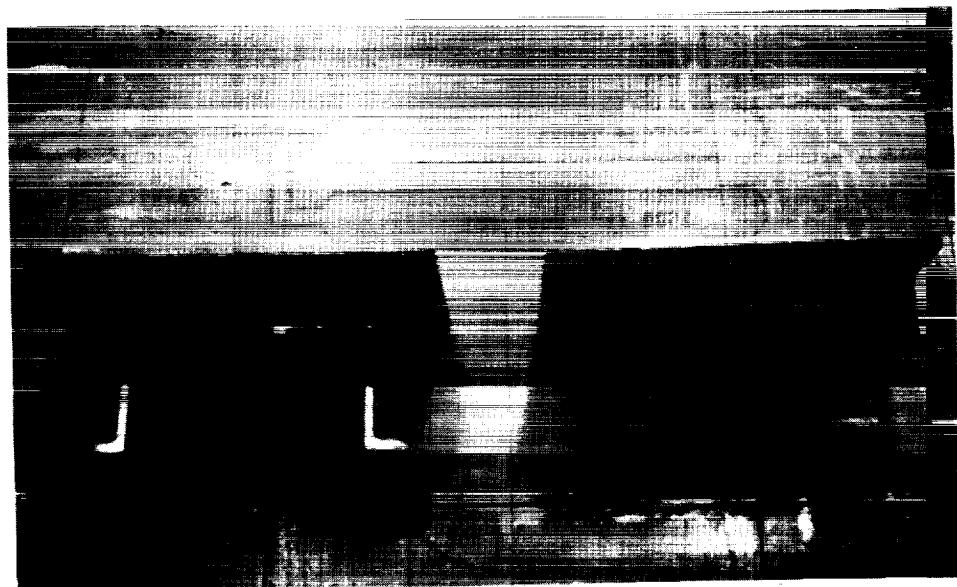
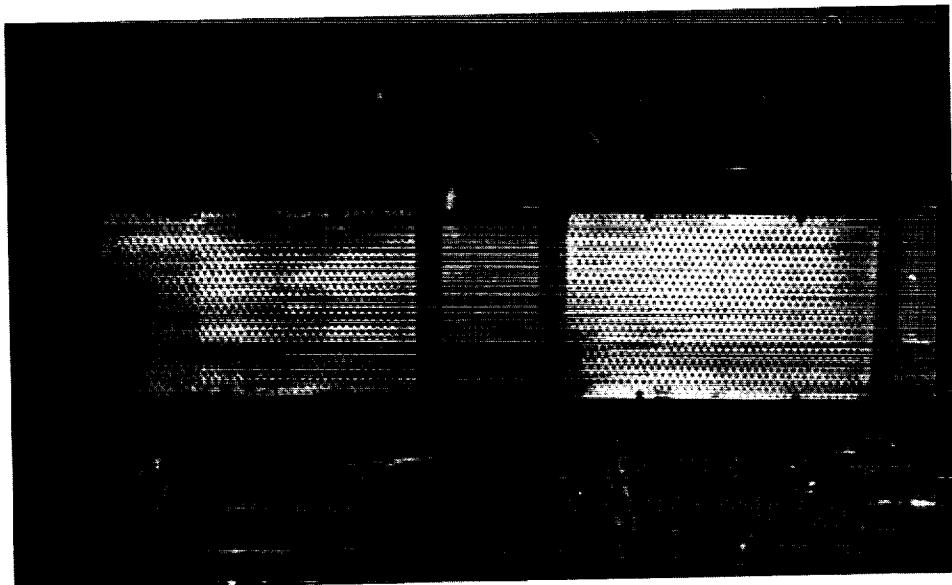


Figure 9. - Porous floor and ceiling plenum chambers.

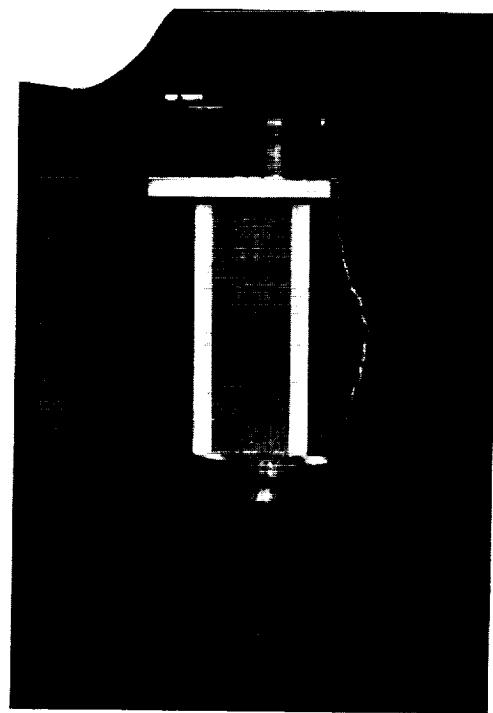


Figure 10. - Traversing wake probe.

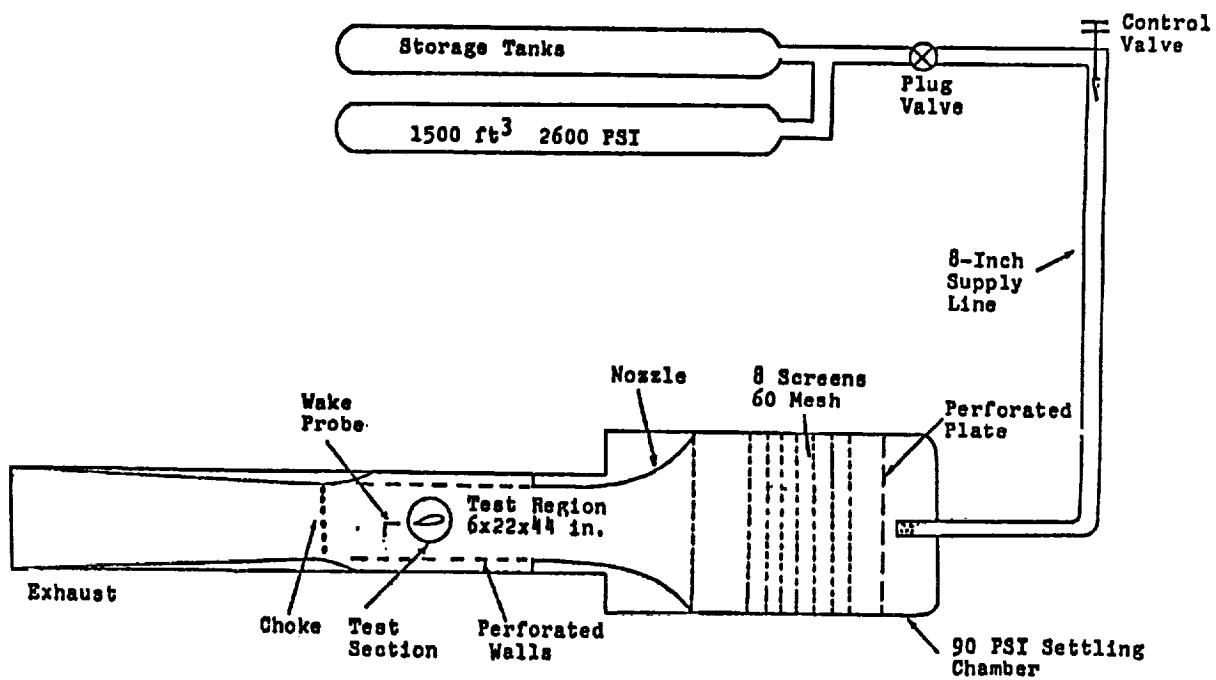
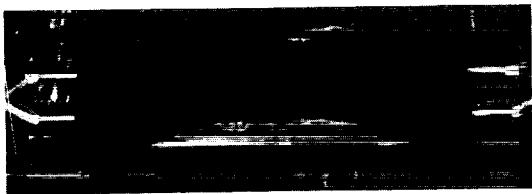
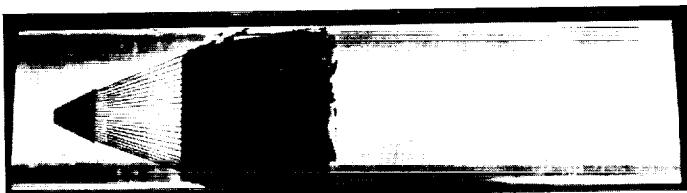


Figure 11. - OSU 6 X 22 Transonic Airfoil Facility.
48

ORIGINAL PAGE IS
OF POOR QUALITY



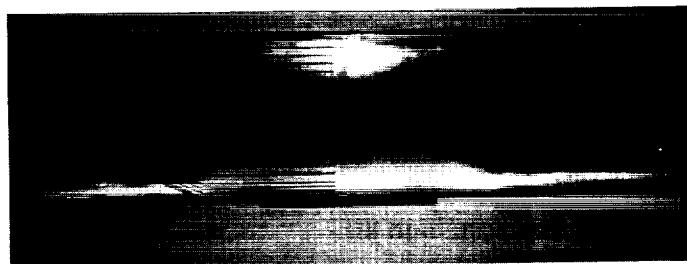
a. NACA 0012



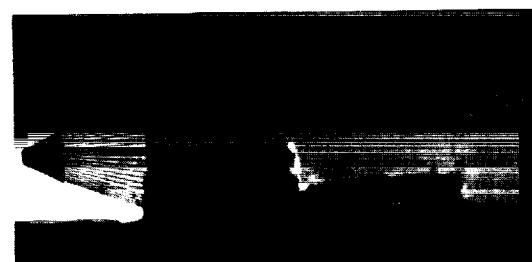
b. SC1095



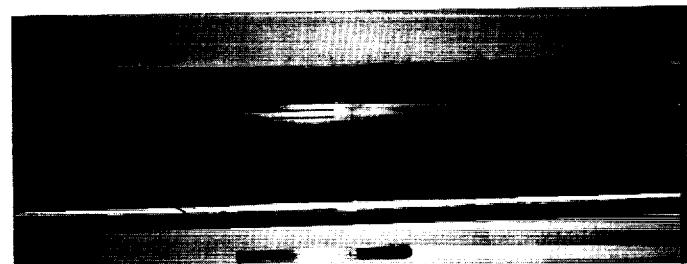
c. VR-7



d. SSC-A09



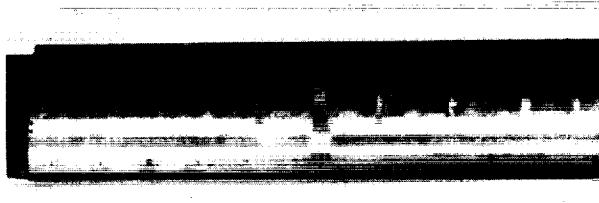
e. SC1094 R8



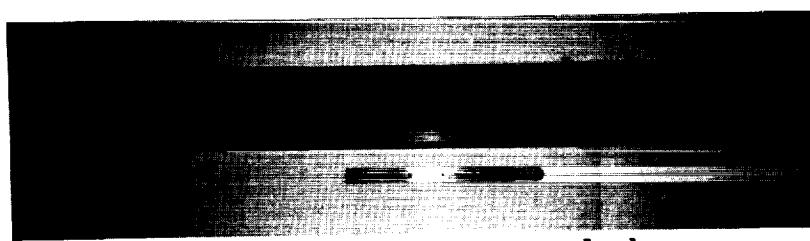
f. SC1012 R8



g. OH-58 Tail Rotor



h. Circulation Control



i. H-34 Model Rotor Blade

Figure 12. - Airfoil models

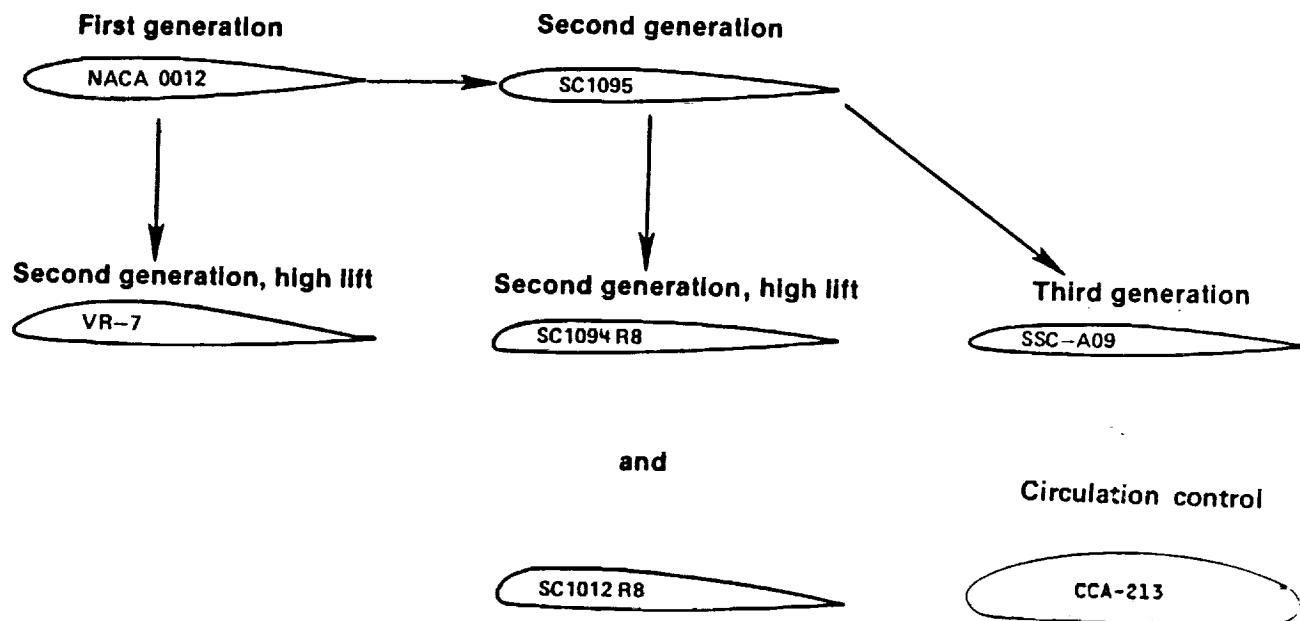


Figure 13. - Airfoil contours.

ORIGINAL PAGE IS
OF POOR QUALITY

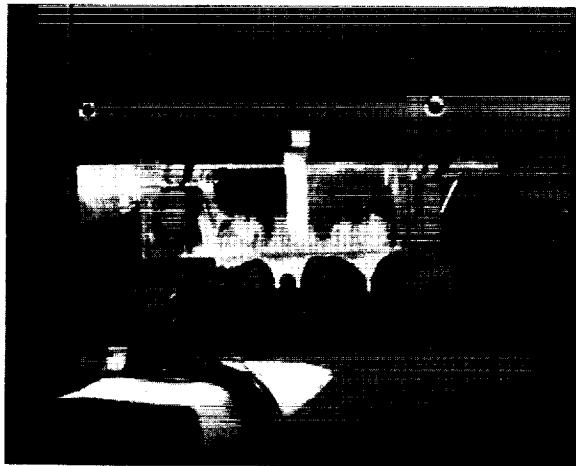


Figure 14. - Ice molding.

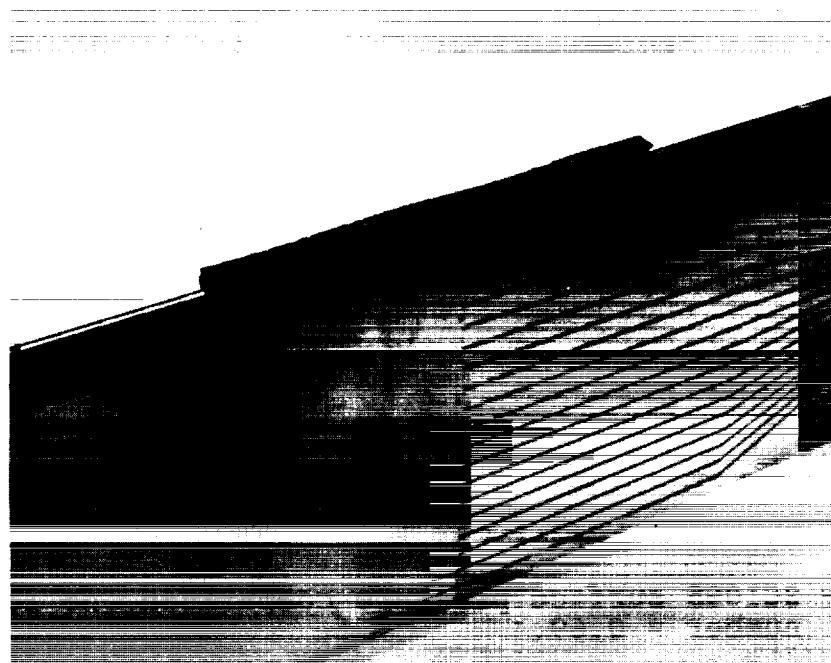


Figure 15. - Ice castings.

FACILITY	M	R _N	α (DEG)	C _L	C _d	C _m
○ NRC	.69	1.9×10^6	3.0	.60	.0259	-.024
— LANGLEY ¹ 6 x 28	.69	5.8×10^6	4.1	.63 ²	.0232	+.014 ³
- - - AMES 11'	.70	5.4×10^6	3.3	.55	.0154	-.010
- - - UTRC 8'	.71	5.4×10^6	4.1	.72		
- - - THEORY	.68	1.9×10^6	3.6	.60		

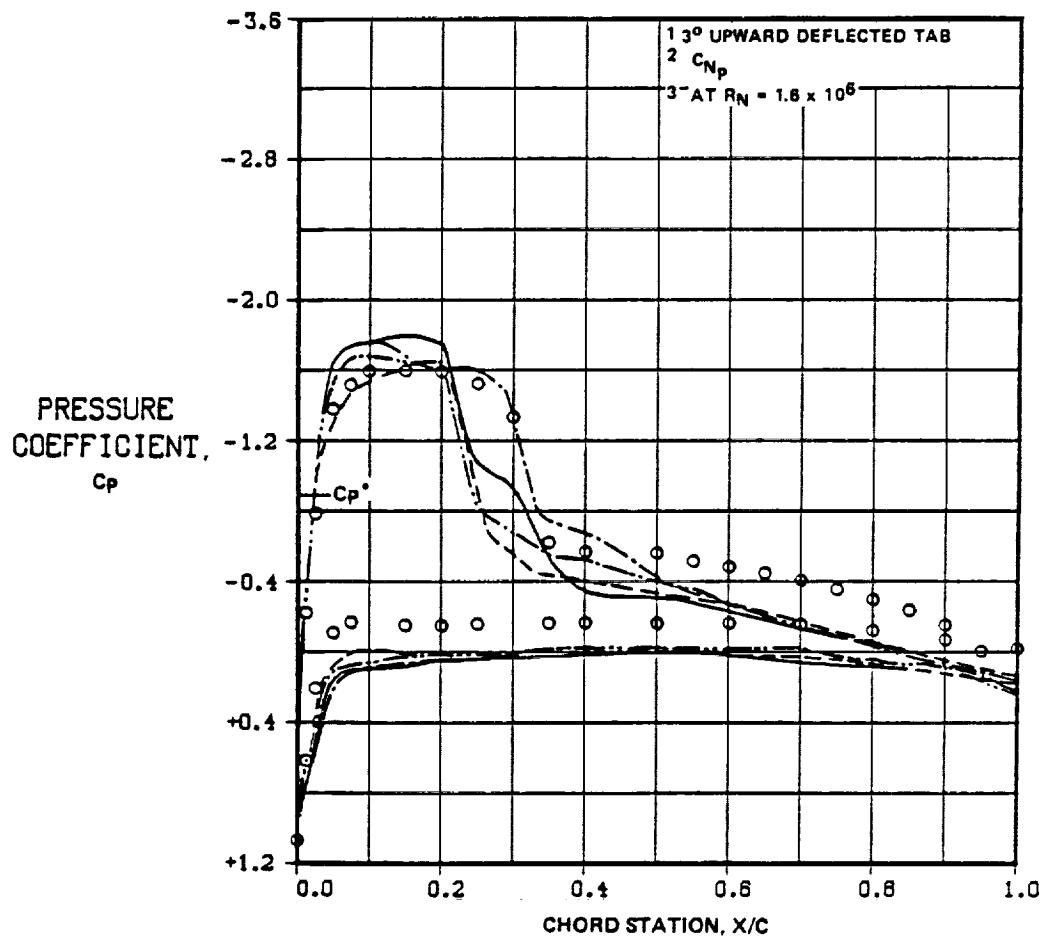


Figure 16. - SC1095 surface pressure comparison, no ice, Mach number = 0.69.

ORIGINAL PAGE IS
OF POOR QUALITY

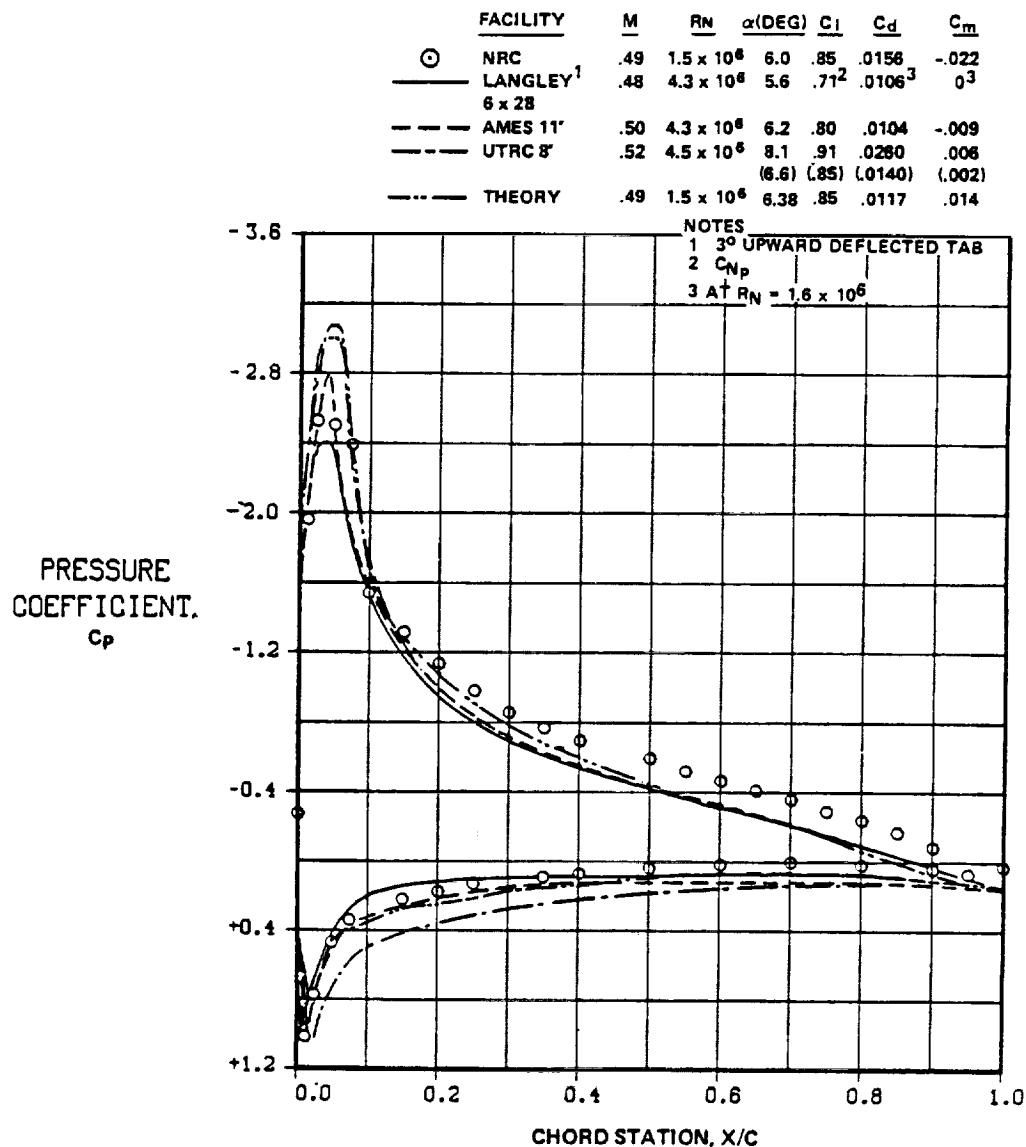
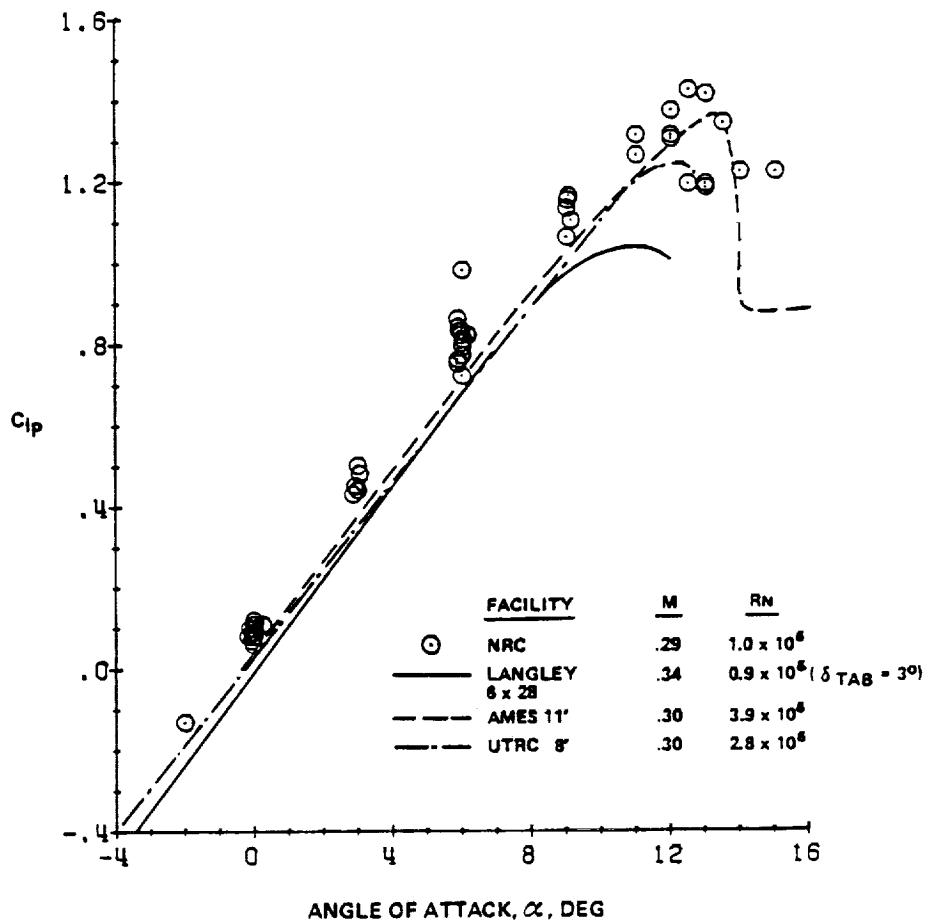
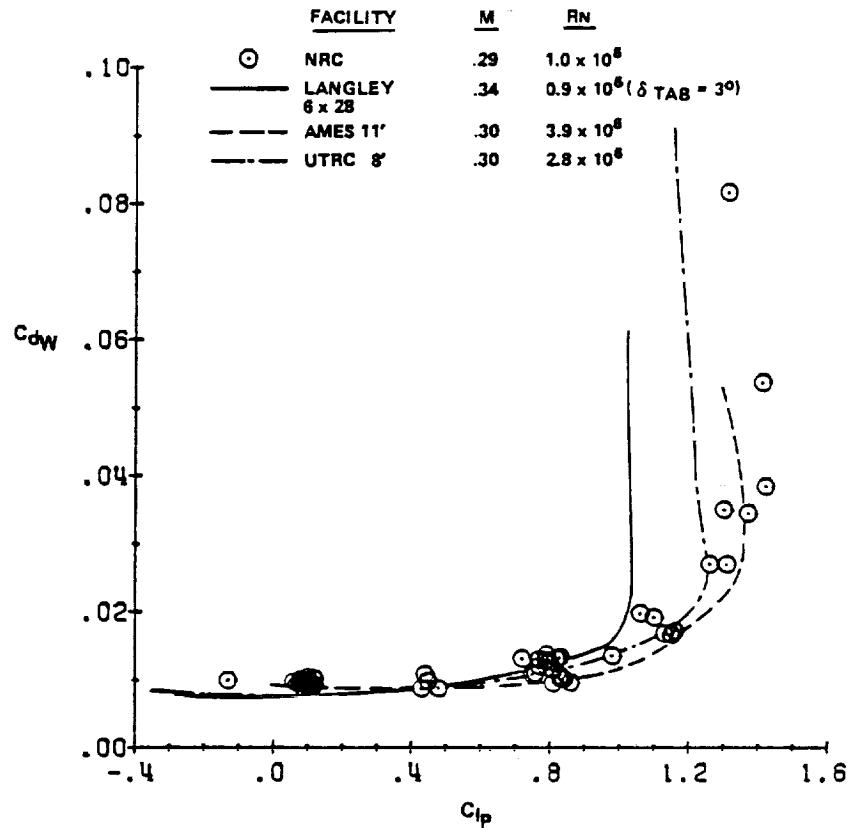


Figure 17. - SC1095 surface pressure comparison, no ice, Mach number = 0.49.



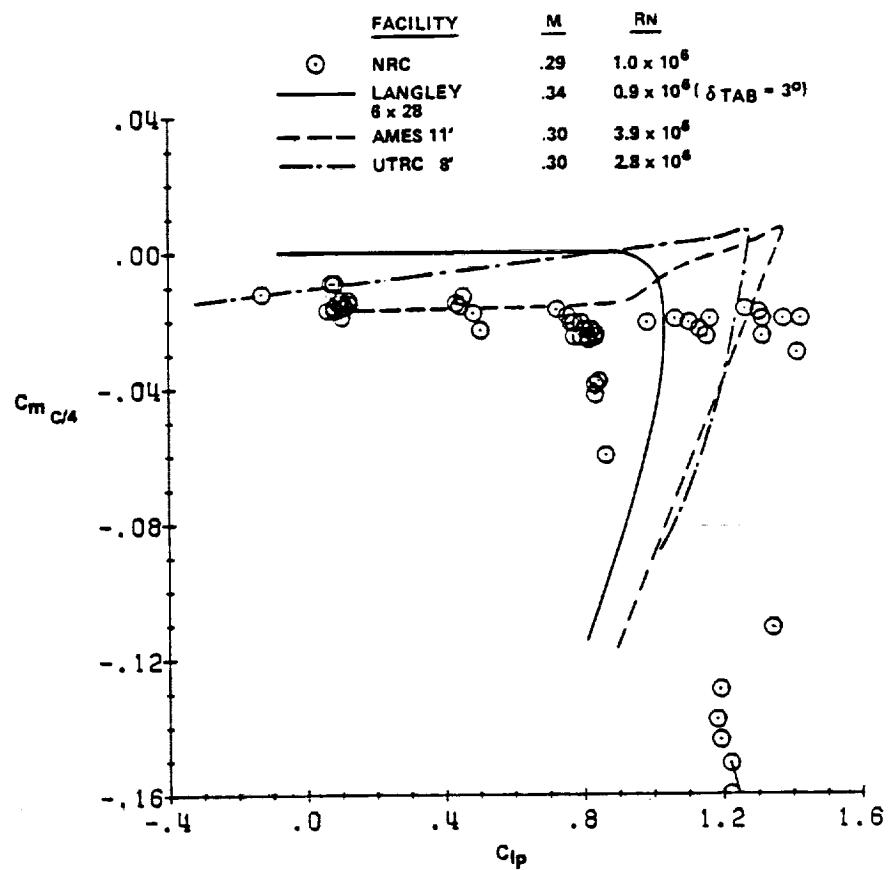
a. Lift coefficient versus angle of attack

Figure 18. - Comparison of force and moment data from several facilities for the SC1095 airfoil, Mach number = 0.29.



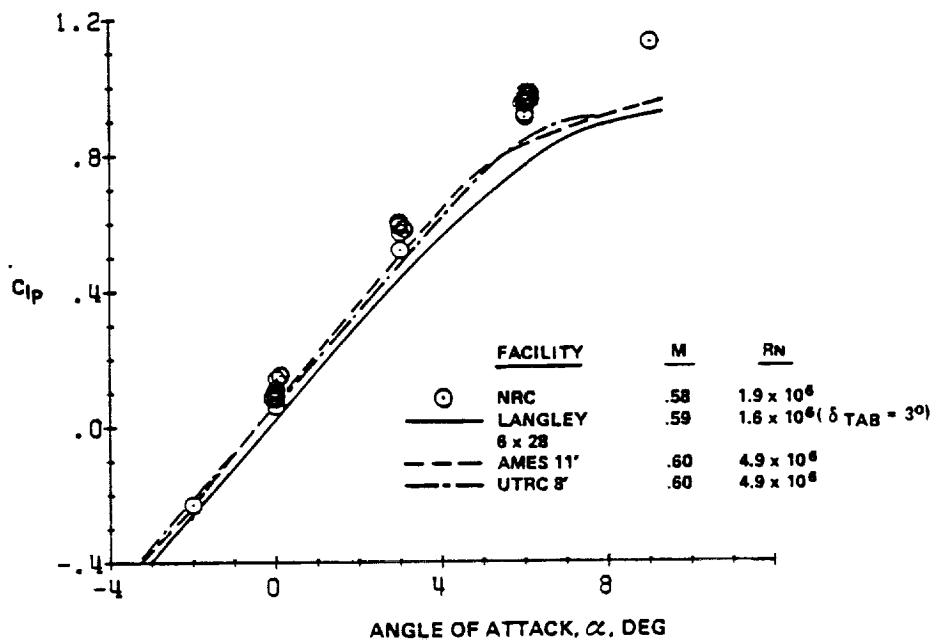
b. Drag coefficient versus lift coefficient

Figure 18. - (Continued)



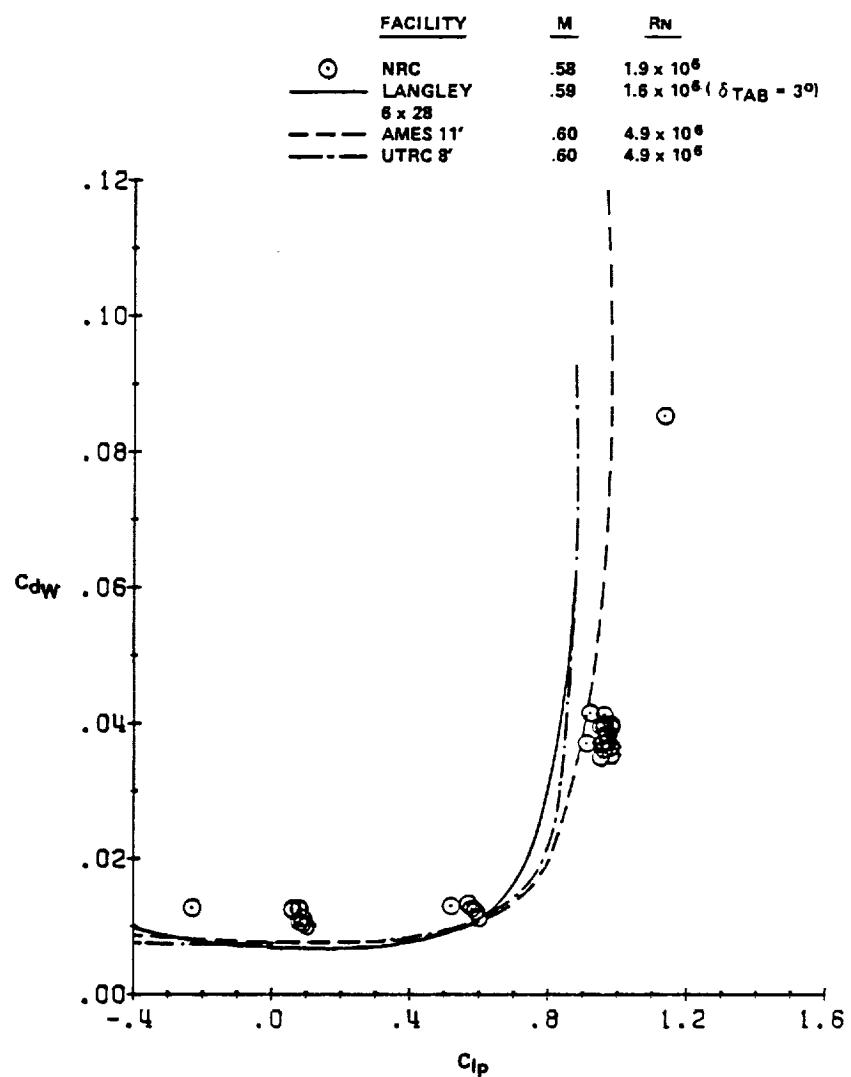
c. Pitching moment coefficient versus lift coefficient

Figure 18. - (Concluded)



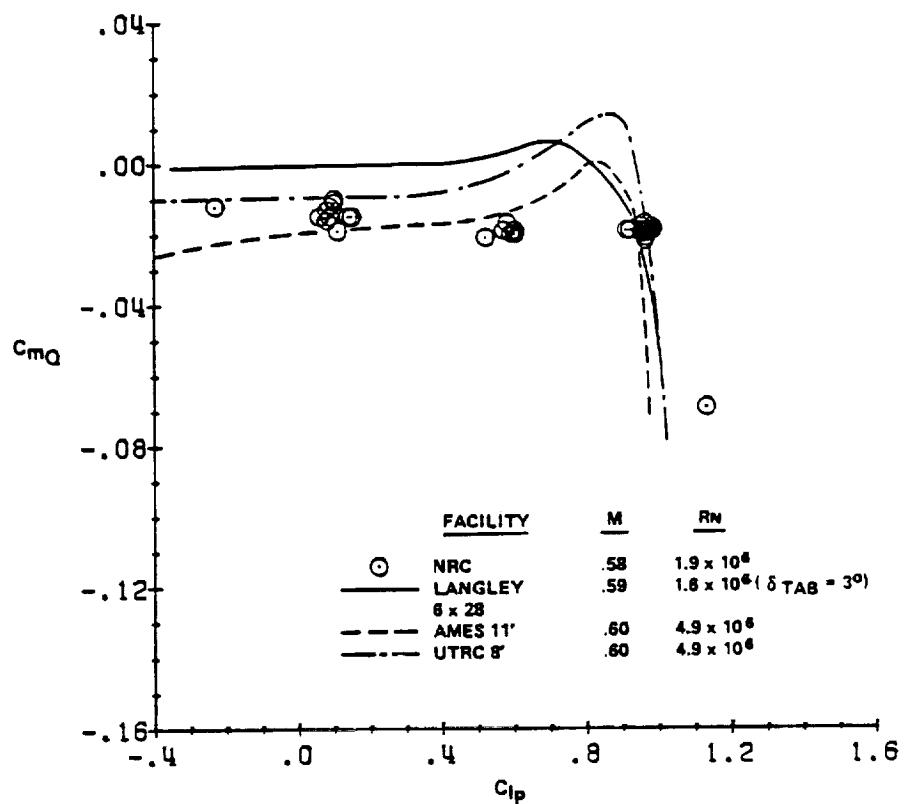
a. Lift coefficient versus angle of attack

Figure 19. - Comparison of force and moment data from several facilities for the SC1095 airfoil, Mach number = 0.58.



b. Drag coefficient versus lift coefficient

Figure 19. - (Continued)



c. Pitching moment coefficient versus lift coefficient

Figure 19. - (Concluded)

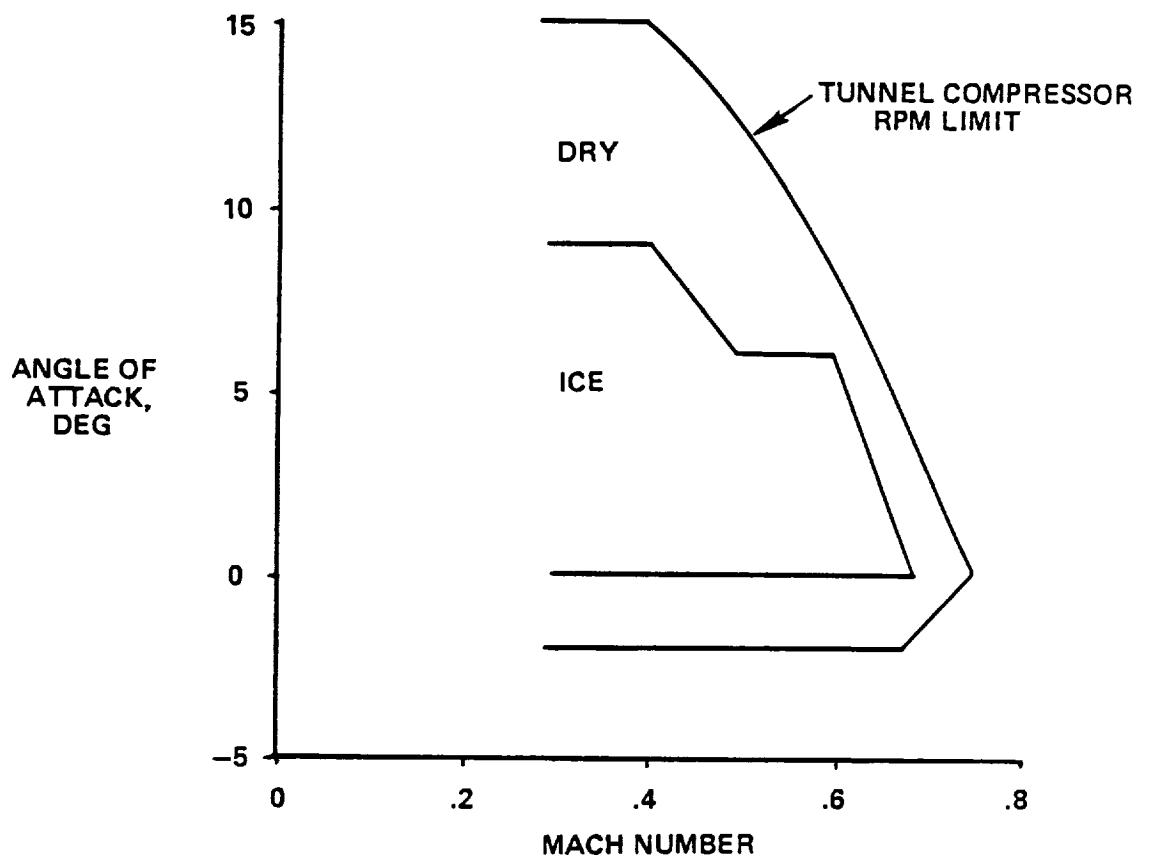


Figure 20. - Nominal test envelope.

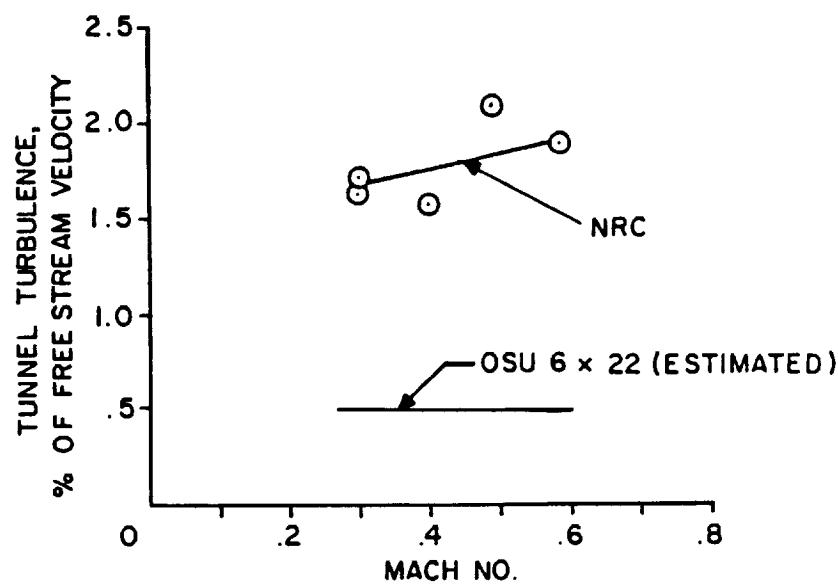
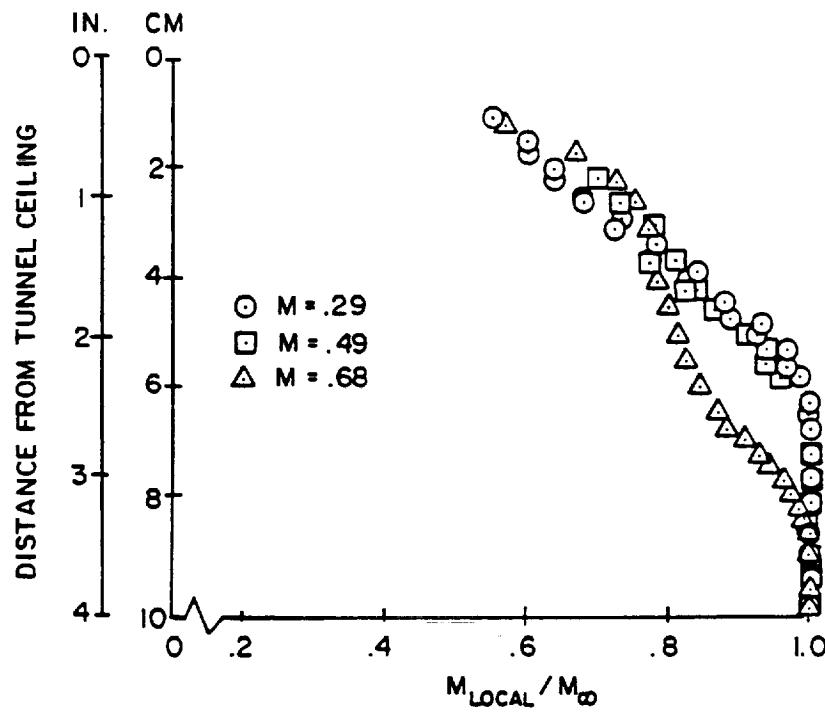


Figure 21. - Tunnel boundary layer and turbulence characteristics.

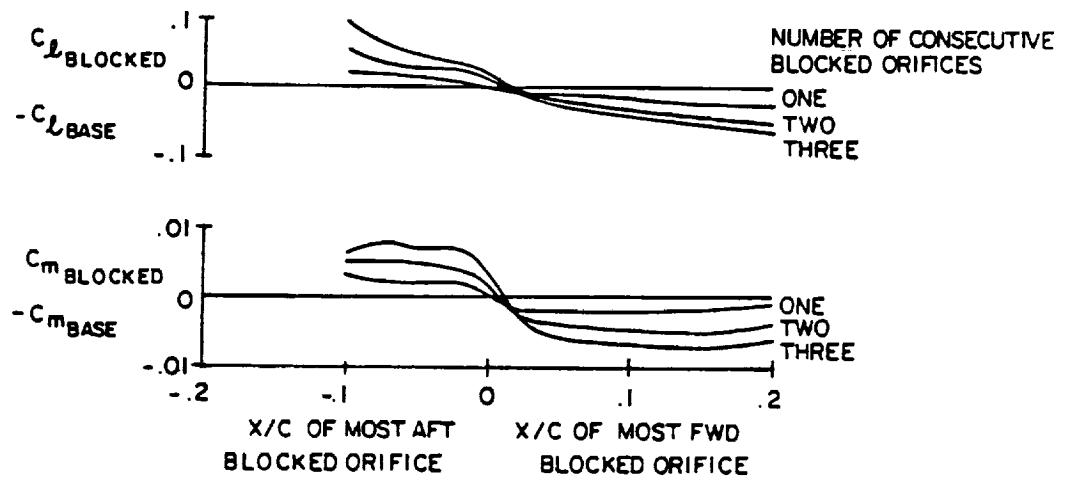
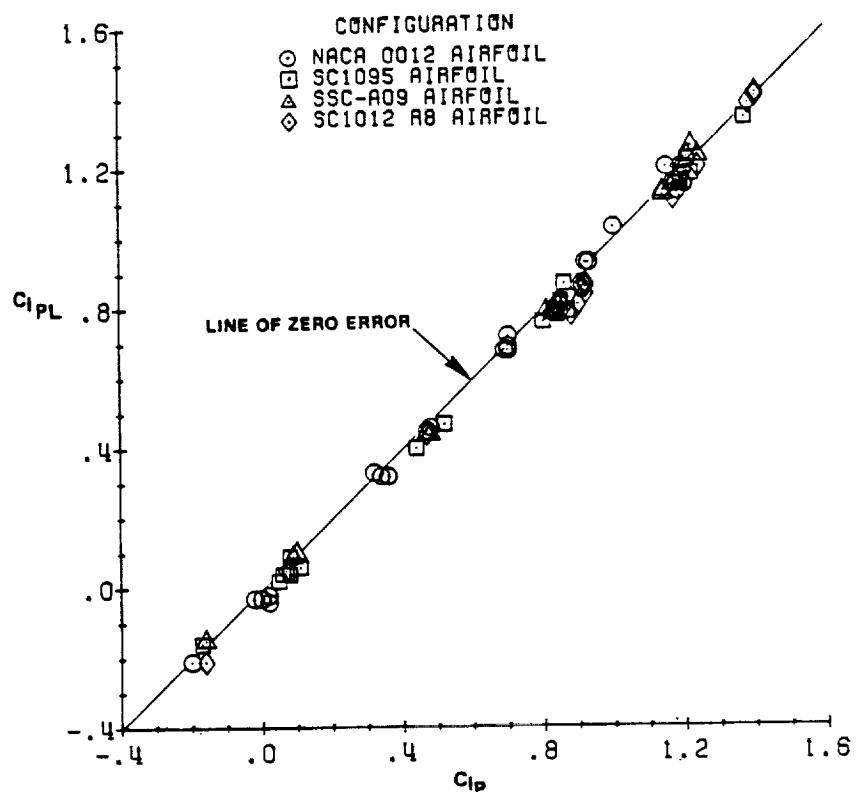


Figure 22. - Effect of airfoil surface pressure orifice error on lift and pitching moment coefficients.



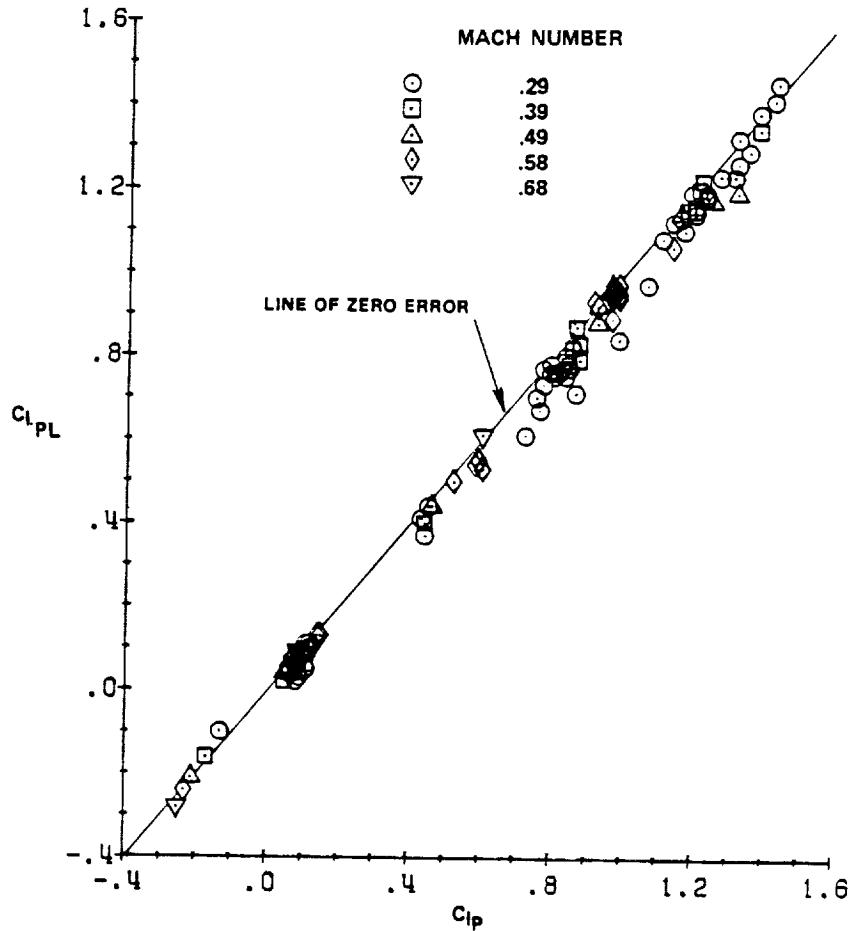


Figure 24. - Plenum chamber lift coefficient correlation for a range of Mach numbers, SC1095 airfoil.

ORIGINAL PAGE IS
OF POOR QUALITY

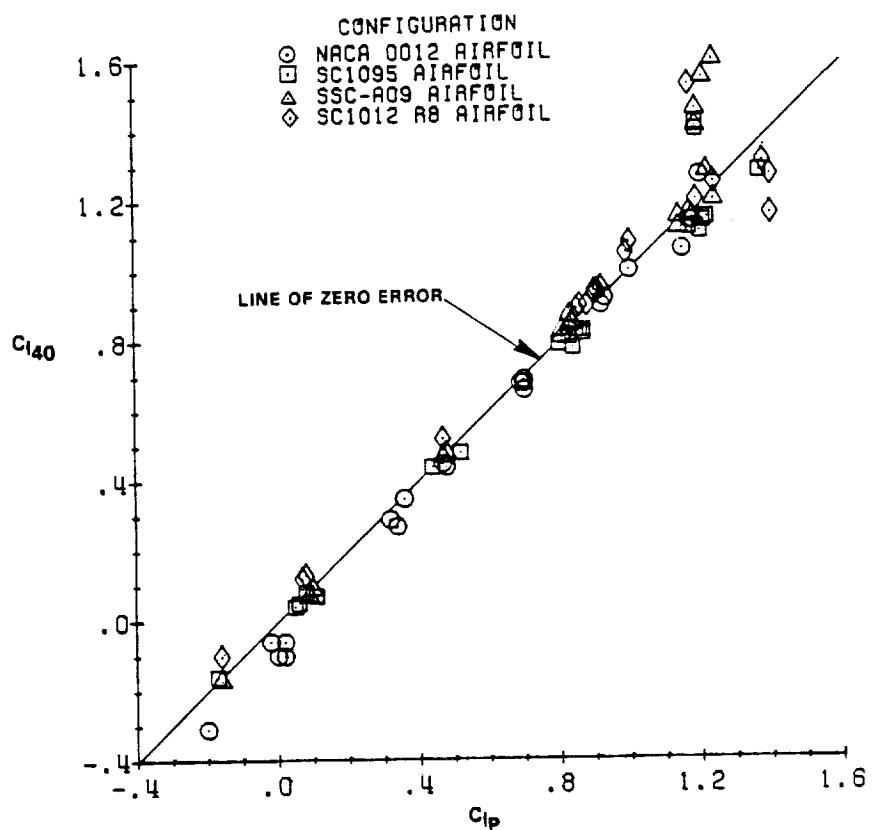


Figure 25. - Correlation of 40% chord station differential pressure lift coefficient versus integrated surface pressure lift coefficient for several airfoil models, Mach number = 0.39.

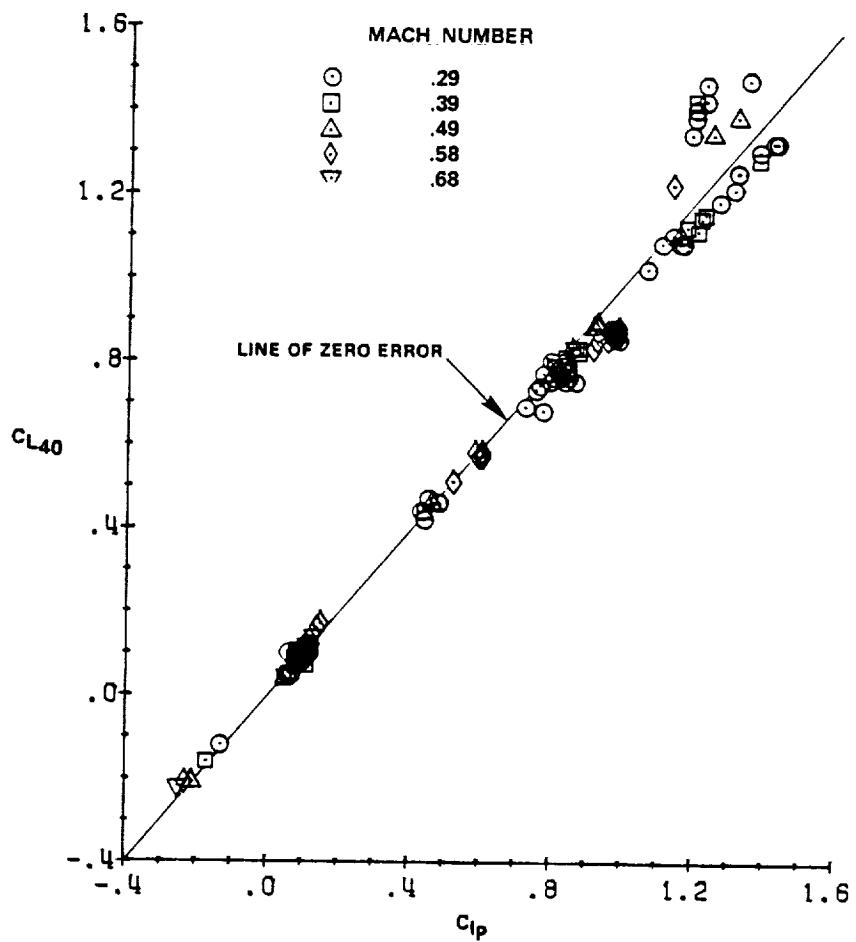


Figure 26. - Correlation of 40% chord station differential pressure lift coefficient versus integrated surface pressure lift coefficient for a range of Mach numbers, SC1095 airfoil.

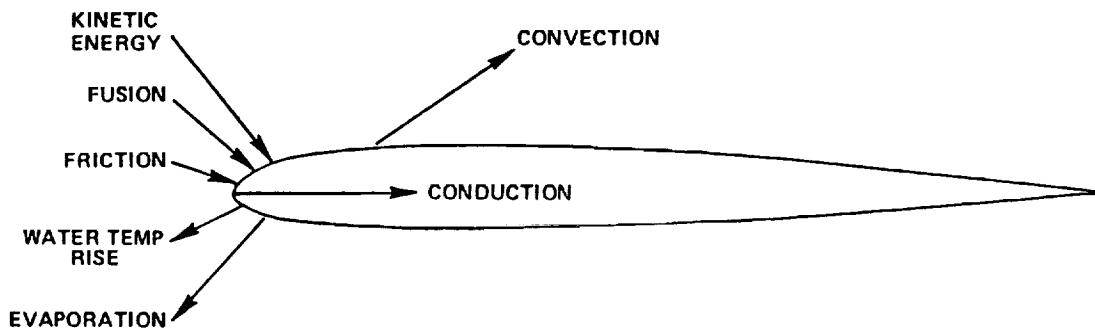


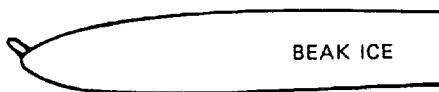
Figure 27. - The thermodynamics of an airfoil in icing conditions.

ORIGINAL PAGE IS
OF POOR QUALITY

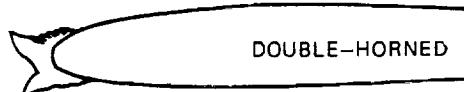
DRY GROWTH (RIME)



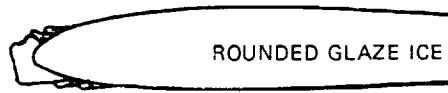
WET GROWTH (GLAZE)



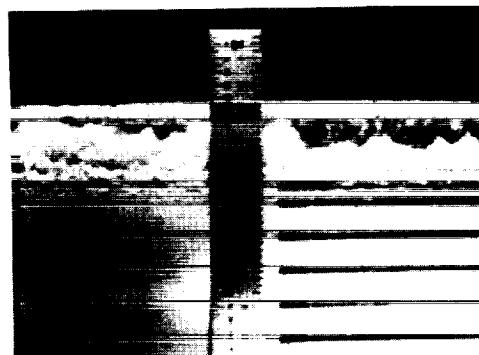
DOUBLE-HORNED



ROUNDED GLAZE ICE

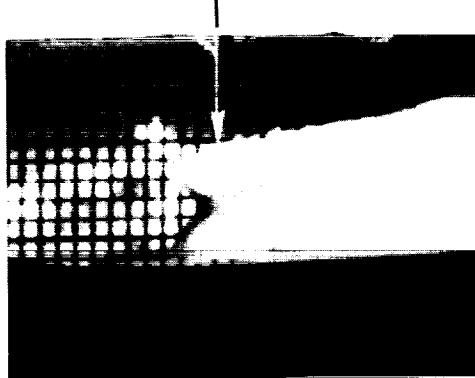


LEADING
EDGE OF
AIRFOIL →



SIDE VIEW
LEADING
EDGE OF
AIRFOIL

SC1012 R8 AIRFOIL
 $M = 0.69, \alpha = 0, \text{ DEG}$
 $LWC = .64 \text{ G/M}^3$
ICING TIME = 45 SEC



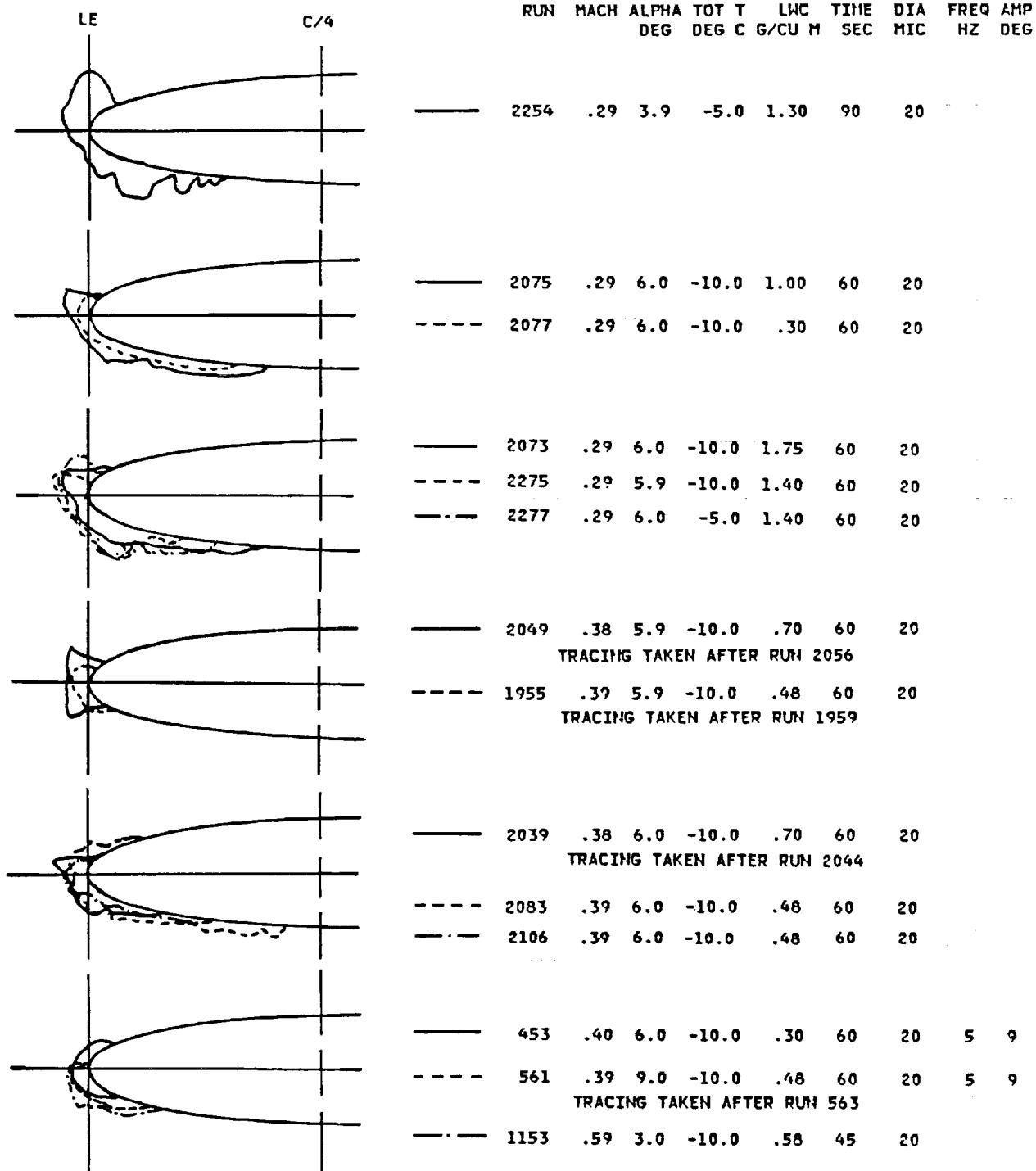


Figure 29. - NACA 0012 airfoil ice tracings.

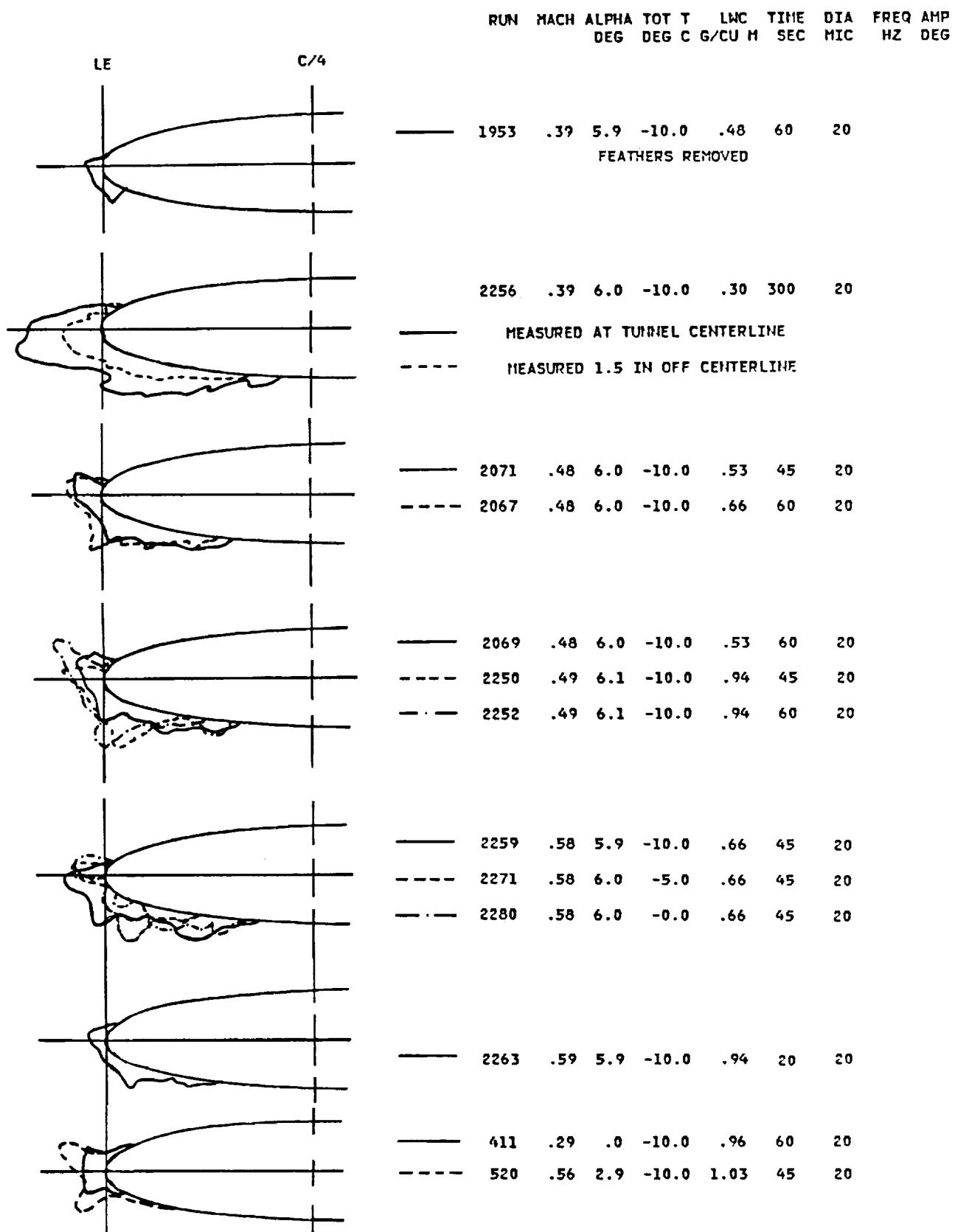


Figure 29. - (Continued)

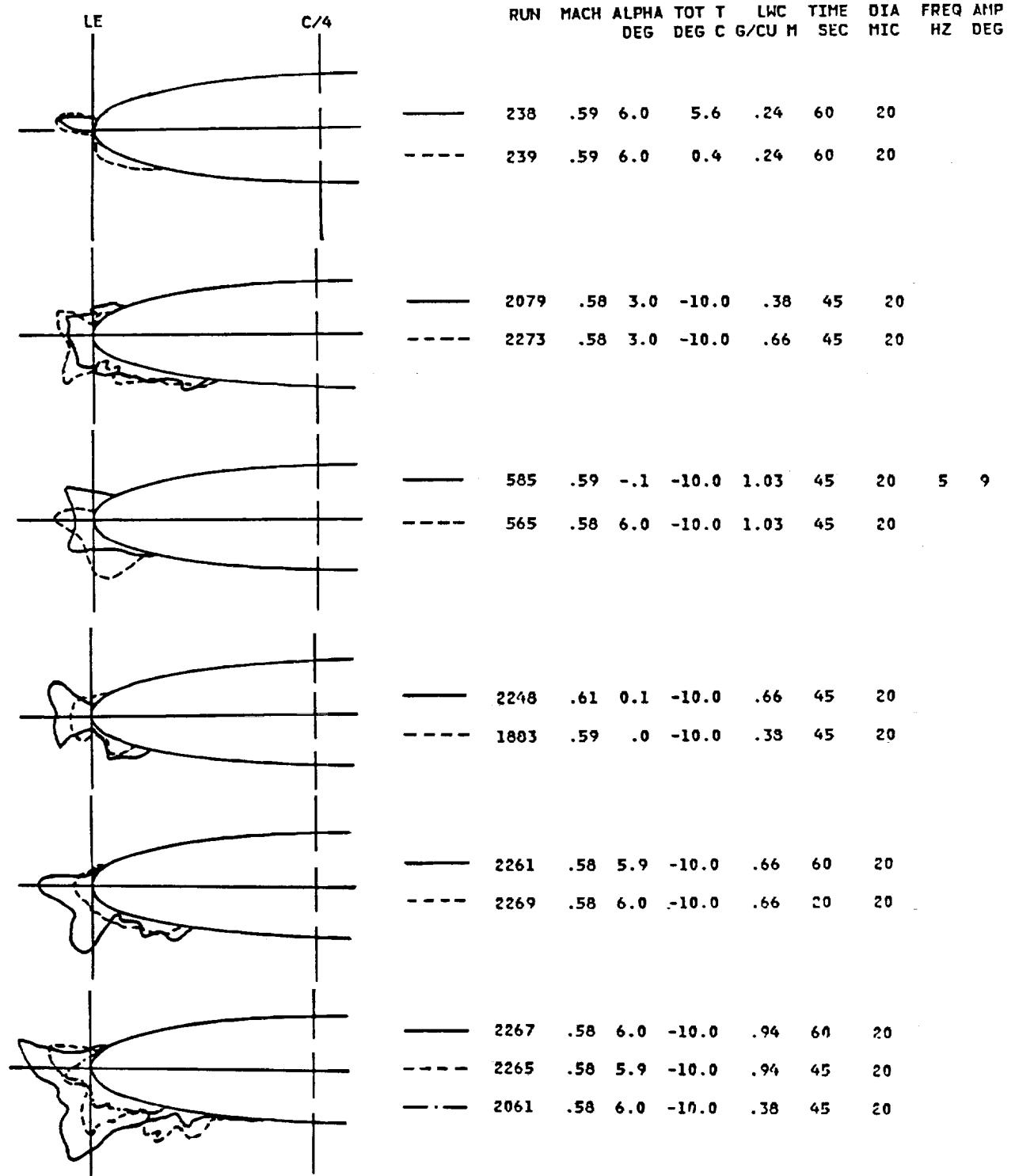


Figure 29. - (Concluded)

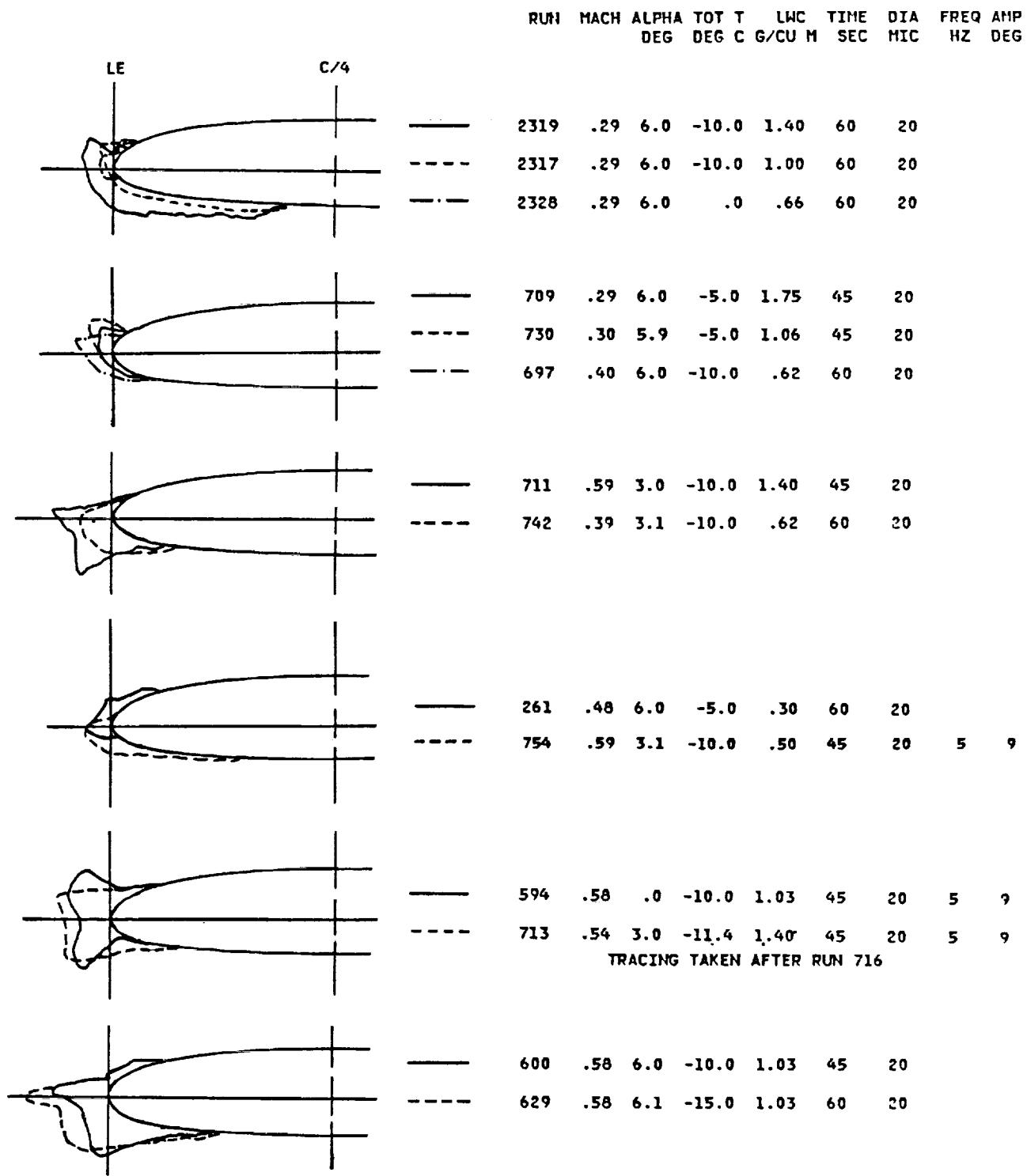


Figure 30. - SC1095 airfoil ice tracings.

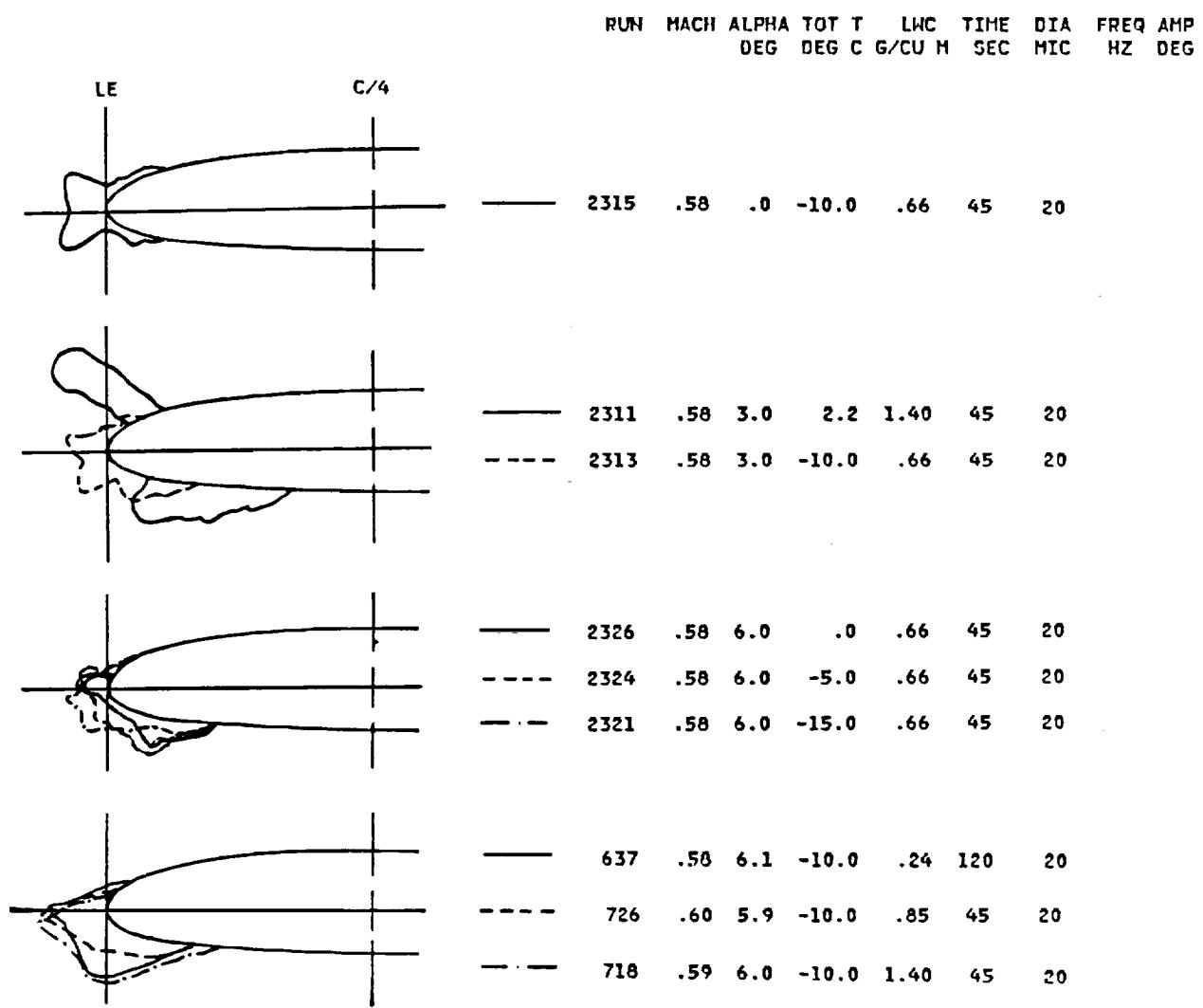
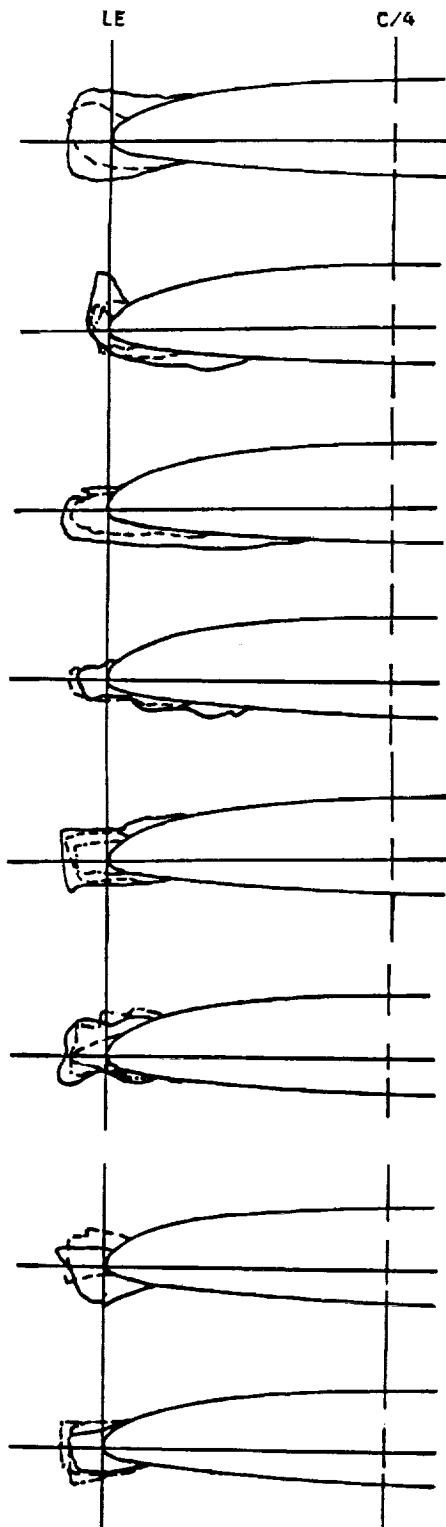
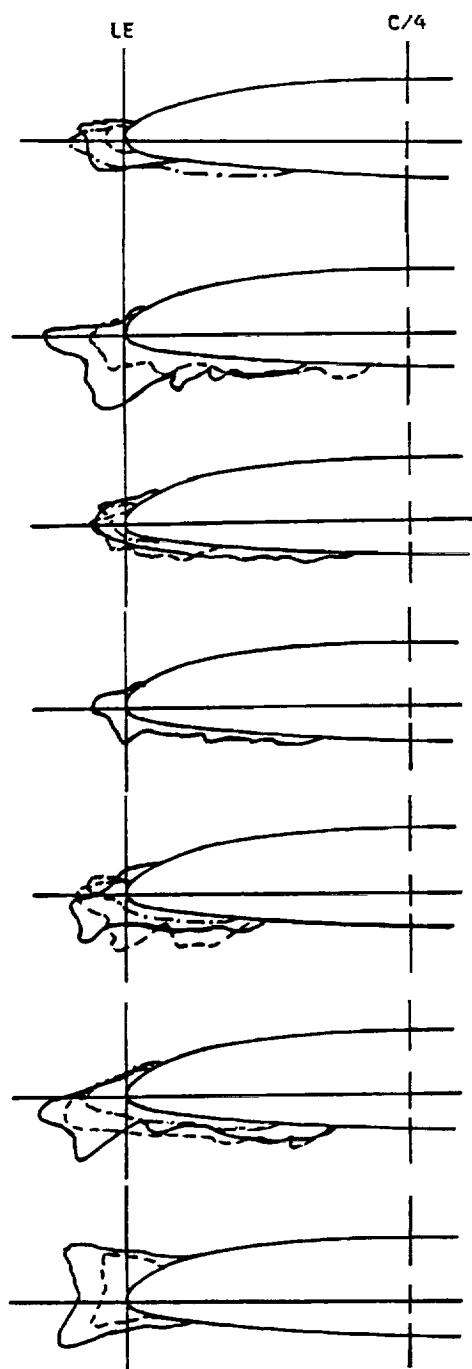


Figure 30. - (Concluded)



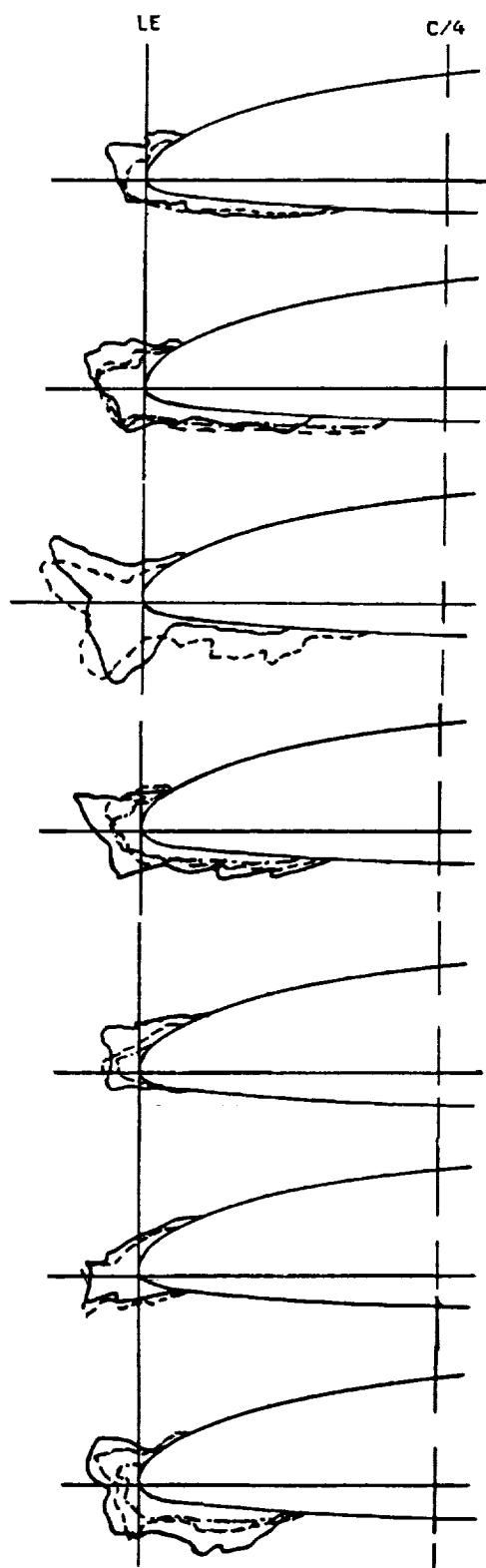
	RUN	MACH	ALPHA	TOT T	LWC	TIME	DIA	FREQ	AMP
		DEG	DEG	C G/CU M	SEC		MIC	Hz	DEG
—	1102	.29	.0	-10.0	1.75	60	20		
---	923	.27	6.0	-10.0	1.75	60	20		
—	2144	.29	6.0	-5.0	1.00	60	20		
---	2146	.29	6.0	-5.0	.66	60	20		
—·—	2148	.29	6.0	-5.0	.35	60	20		
—	2142	.29	6.0	-20.0	1.00	60	20		
---	2140	.29	6.0	-20.0	.66	60	20		
—	2117	.38	6.0	-10.0	.48	60	20		
TRACING TAKEN AFTER RUN 2129									
---	2162	.39	6.0	-10.0	.48	60	20		
—	1114	.58	3.0	-10.0	.58	45	20	2.5	9
---	1116	.59	3.0	-10.0	.58	45	20	5	5
—·—	884	.38	5.9	-10.0	.62	60	20	5	9
TRACING TAKEN AFTER RUN 886									
—	2228	.57	.0	-10.0	.58	45	20		
TRACING TAKEN AFTER RUN 2234									
---	2152	.58	.0	-10.0	.33	45	20	5	9
TRACING TAKEN AFTER RUN 2160									
—·—	2150	.58	.0	-10.0	.35	45	20		
—	931	.59	6.0	-10.0	.85	45	20		
---	1088	.57	.0	-10.0	.58	45	20	5	9
—	859	.59	6.2	-10.0	.50	45	20		
---	861	.59	.0	-10.0	.50	45	20		
—·—	868	.58	.0	-10.0	.50	60	20		
TRACING TAKEN AFTER RUN 869									

Figure 31. - SSC-A09 airfoil ice tracings.



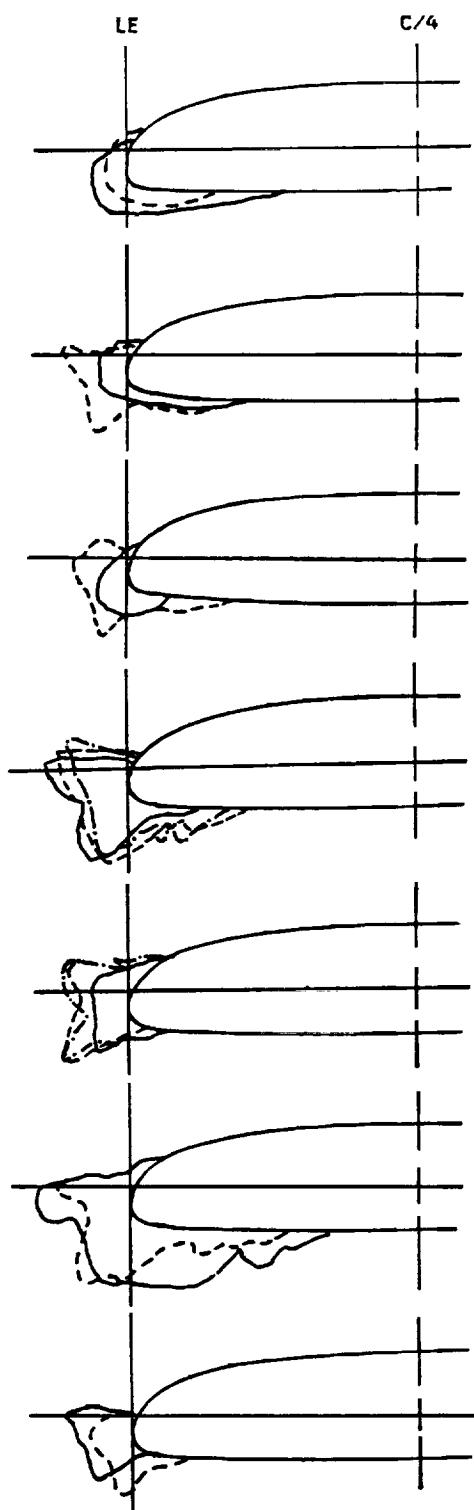
	RUN	MACH	ALPHA	TOT T DEG	LWC G/CU M	TIME SEC	DIA MIC	FREQ HZ	AMP DEG
	927	.59	6.0	-10.0	.85	30	20		
	1110	.59	6.0	-10.0	.35	30	20		
	1112	.59	6.0	-10.0	1.31	30	20		
	2218	.58	5.9	-10.0	.85	60	20		
	2132	.58	6.0	-10.0	.49	60	20		
	2134	.58	6.0	-20.0	.53	45	20		
	2113	.58	6.0	-5.0	.35	45	20		
	2108	.58	5.9	.0	.38	45	20		
	2115	.58	6.0	-5.0	.38	45	20		
	2220	.58	5.9	-18.9	.66	45	20		
	2226	.58	5.9	-5.0	.66	45	20		
	2225	.58	5.9	.0	.66	45	20		
	2222	.58	5.9	-18.9	1.00	45	20		
	2138	.58	6.0	-20.0	.62	45	20		
	2136	.58	6.0	-20.0	.35	45	20		
	1129	.56	.0	-10.0	1.36	45	20	5	9
	1122	.67	.0	-10.0	.64	45	20	5	9

Figure 31. - (Concluded)



	RUN	MACH	ALPHA	TOT T	LWC	TIME	DIA	FREQ	AMP
		DEG	DEG	C G/CU M	SEC	HIC	Hz	deg	
—	2166	.29	5.8	-10.0	1.20	60	20		
---	2164	.29	5.8	-10.0	.30	60	20		
—	2170	.38	5.8	-10.0	1.40	60	20		
---	2172	.39	5.8	-10.0	1.00	60	20		
—	2168	.38	5.8	-10.0	.76	60	20		
—	2192	.48	6.0	-10.0	1.00	90	20		
---	2178	.48	5.8	-10.0	1.00	90	20		
—	2176	.49	5.9	-10.0	1.00	60	20		
---	2174	.48	5.9	-10.0	1.00	30	20		
—	2180	.59	5.8	-10.0	.30	45	20		
—	762	.58	.0	-10.0	.50	60	20		
---	764	.58	.0	-10.0	.50	45	20		
—	770	.40	6.0	-10.0	.62	60	20	5	9
TRACING TAKEN AFTER RUN 773									
—	784	.58	3.0	-10.0	.50	60	20	5	9
TRACING TAKEN AFTER RUN 786									
---	936	.59	3.0	-10.0	.50	60	20		
—	2184	.58	5.8	-10.0	1.00	45	20		
---	2182	.59	5.8	-10.0	.66	45	20		
—	2188	.29	6.0	-10.0	.66	60	20		

Figure 32. - VR-7 airfoil ice tracings.



RUN	MACH	ALPHA	TOT T	LWC	TIME	DIA	FRÉQ	AMP
	DEG	DEG	C	G/CU M	SEC	MIC	Hz	DEG

— 1335 .39 9.0 -10.0 .62 60 20

- - - 1281 .30 6.0 -10.0 .66 60 20

— 1309 .38 6.0 -10.0 .62 60 20

- - - 1363 .47 6.0 -10.0 1.06 60 20 5 9

TRACING TAKEN AFTER RUN 1366

— 1348 .48 6.0 -10.0 .31 60 20

- - - 1346 .48 6.0 -10.0 .72 60 20

— 1379 .59 6.0 -10.0 1.12 45 20

- - - 1419 .46 6.0 -10.0 1.06 60 20

— - - 1385 .58 6.0 -10.0 1.31 45 20 5 9

TRACING TAKEN AFTER RUN 1388

— 1401 .57 .0 -10.0 .58 45 20 5 9

TRACING TAKEN AFTER RUN 1404

- - - 1413 .56 .0 -10.0 .58 60 20

— - - 1425 .63 .0 -10.0 .64 45 20

— 1417 .59 6.0 -10.0 1.50 45 20

- - - 1383 .58 6.0 -10.0 1.50 45 20

— 1359 .59 6.0 -10.0 .58 60 20

- - - 1357 .58 6.0 -10.0 .58 45 20

Figure 33. - SC1094 R8 airfoil ice tracings.

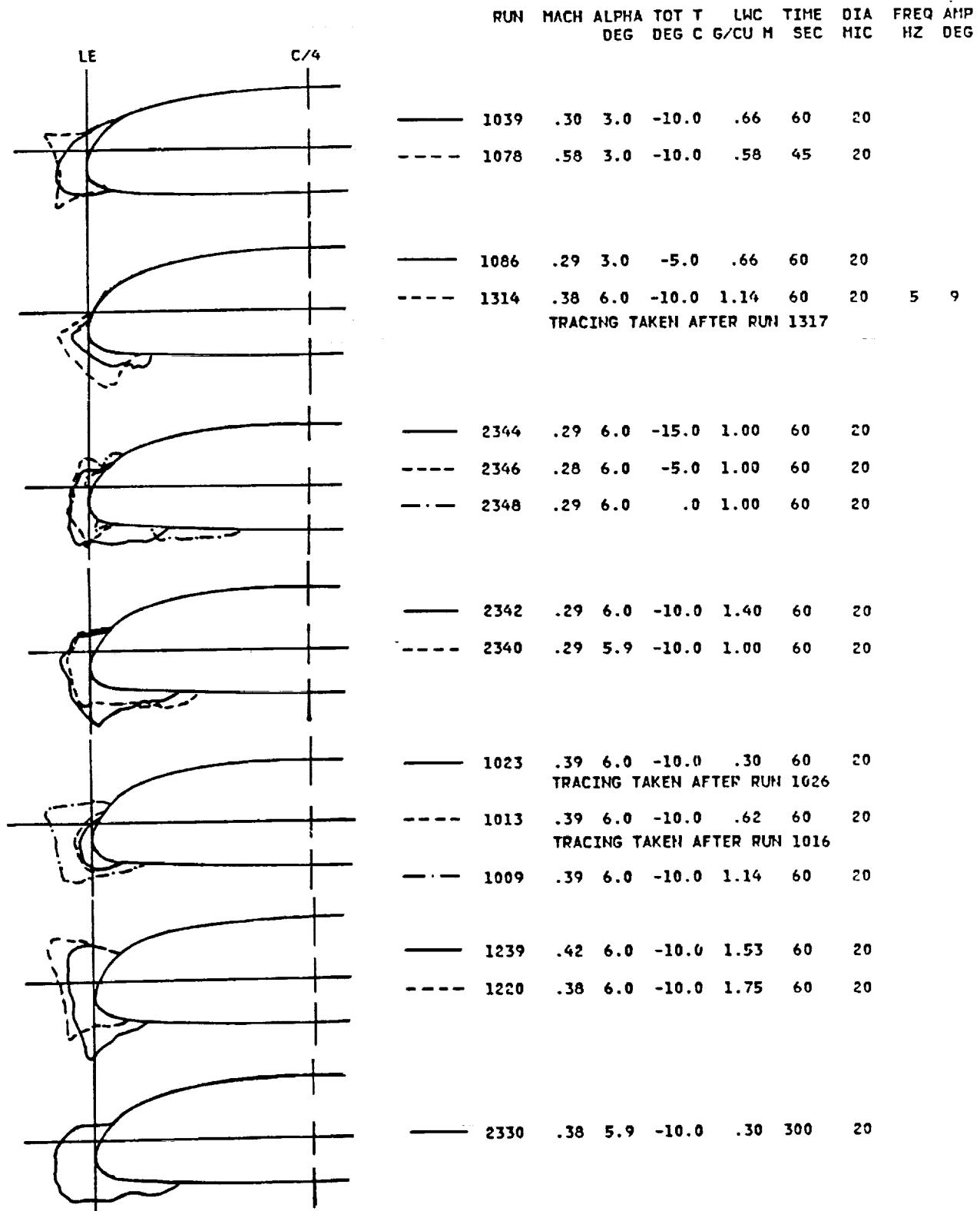


Figure 34. - SC1012 R8 airfoil ice tracings.

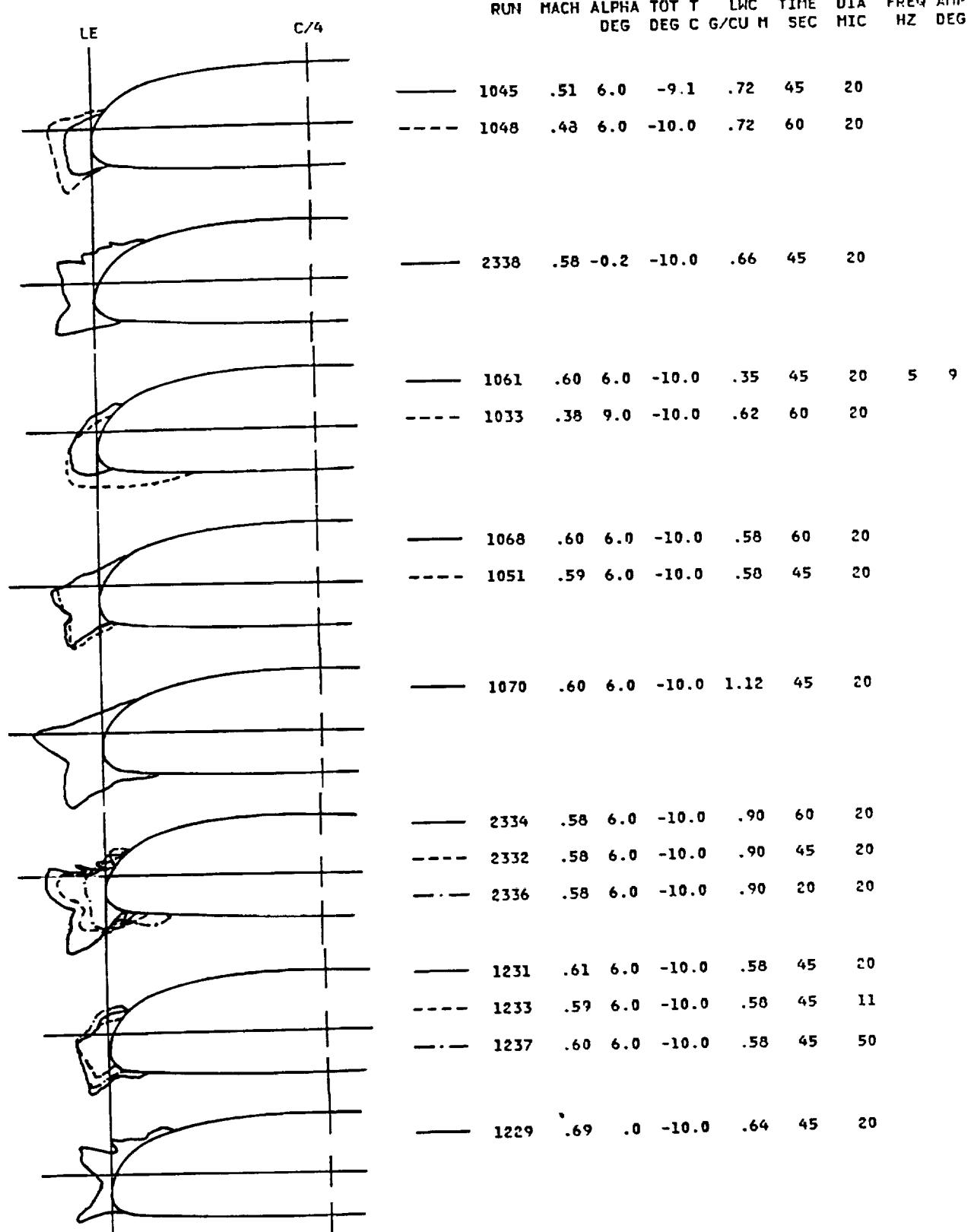


Figure 34. - (Concluded)

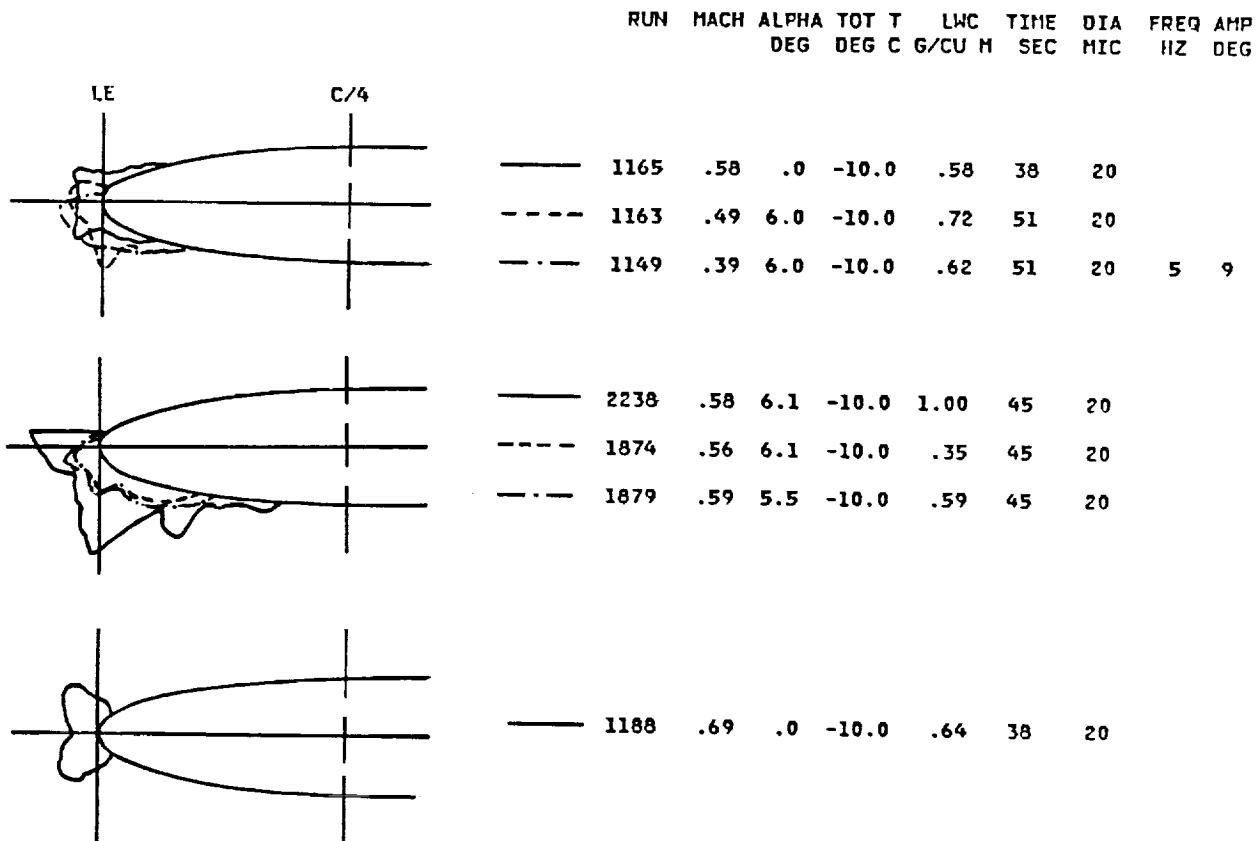


Figure 35. - OH-58 tail rotor ice tracings.

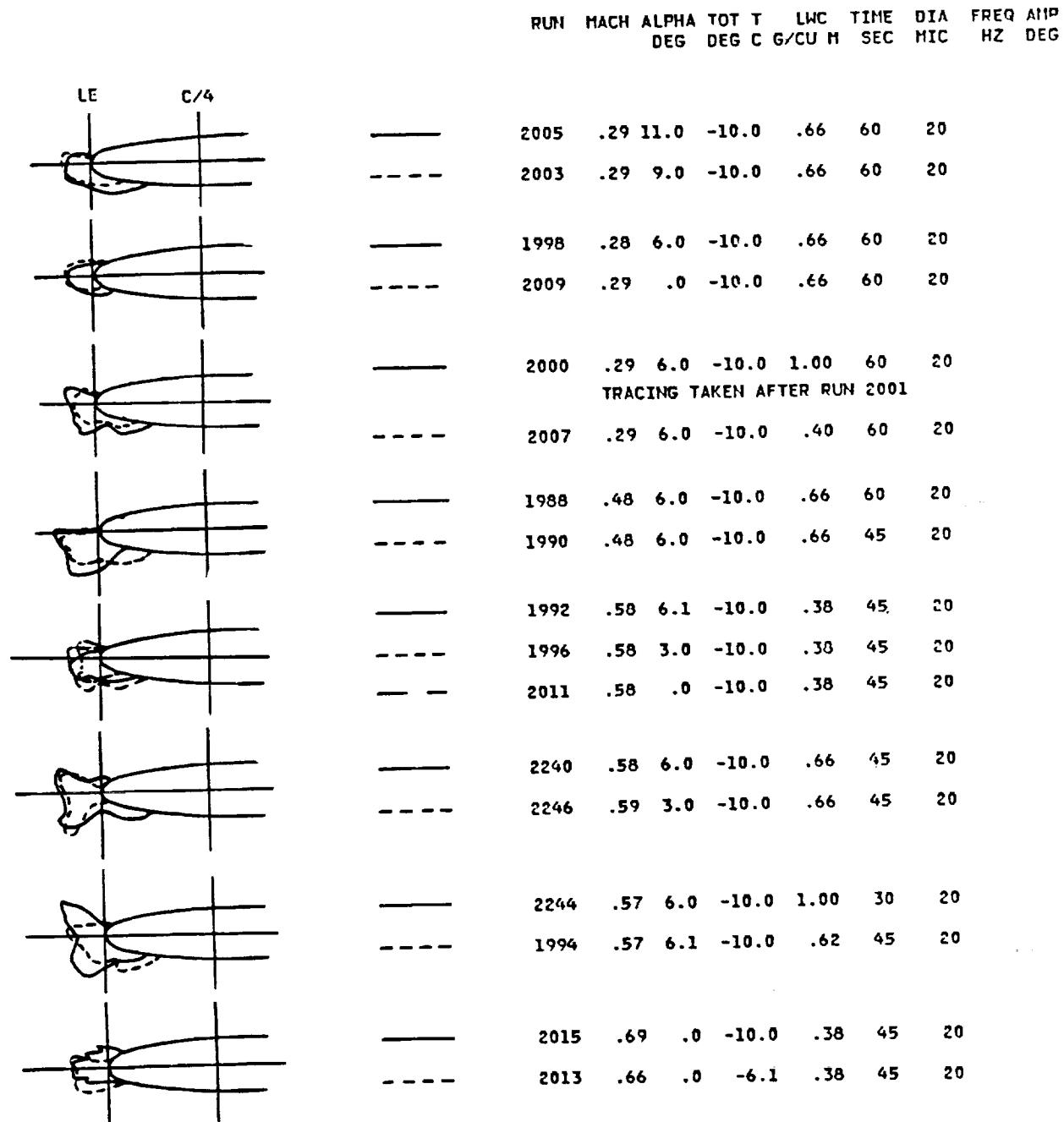


Figure 36. - S-58 scale rotor blade ice tracings.

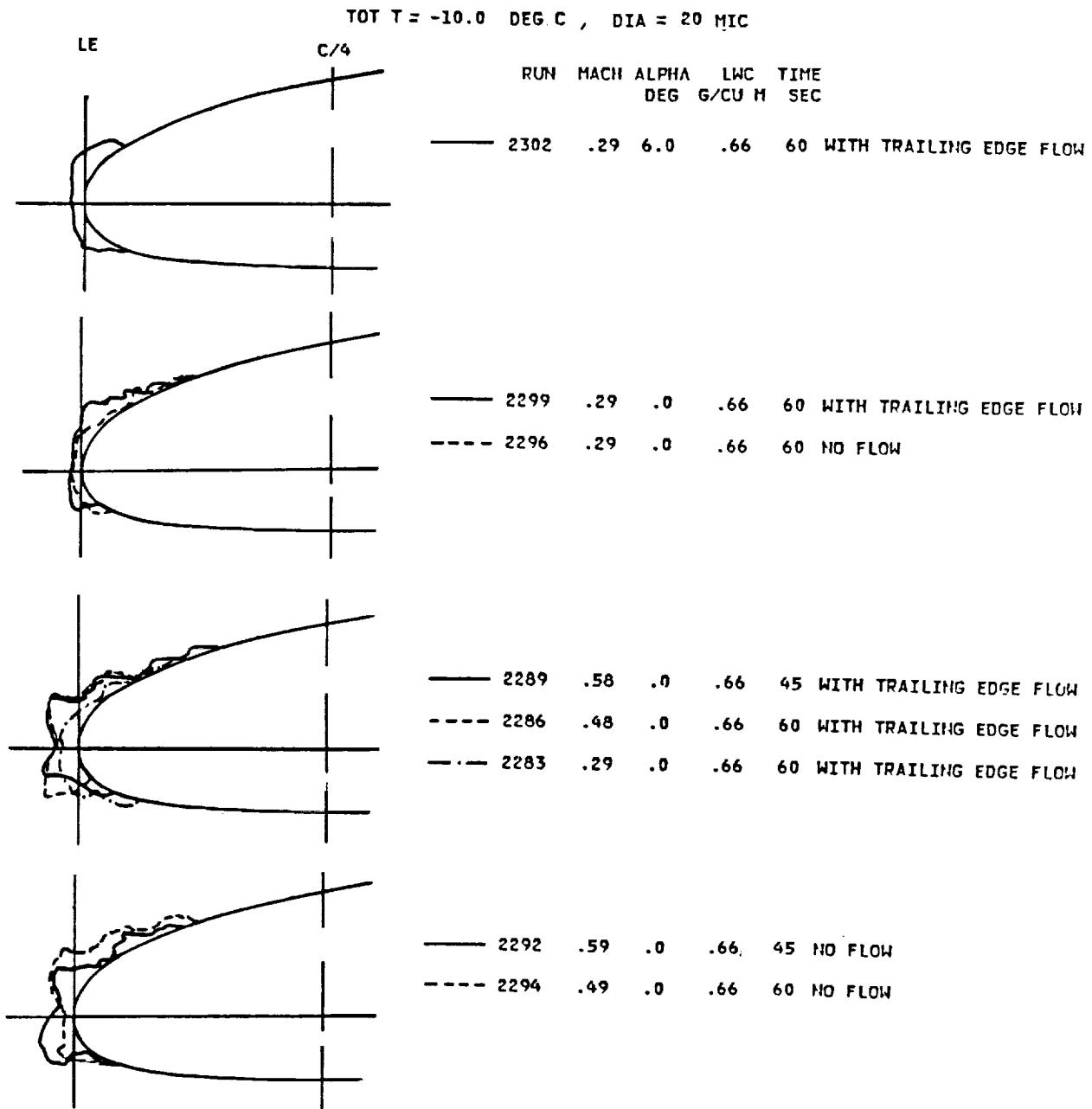
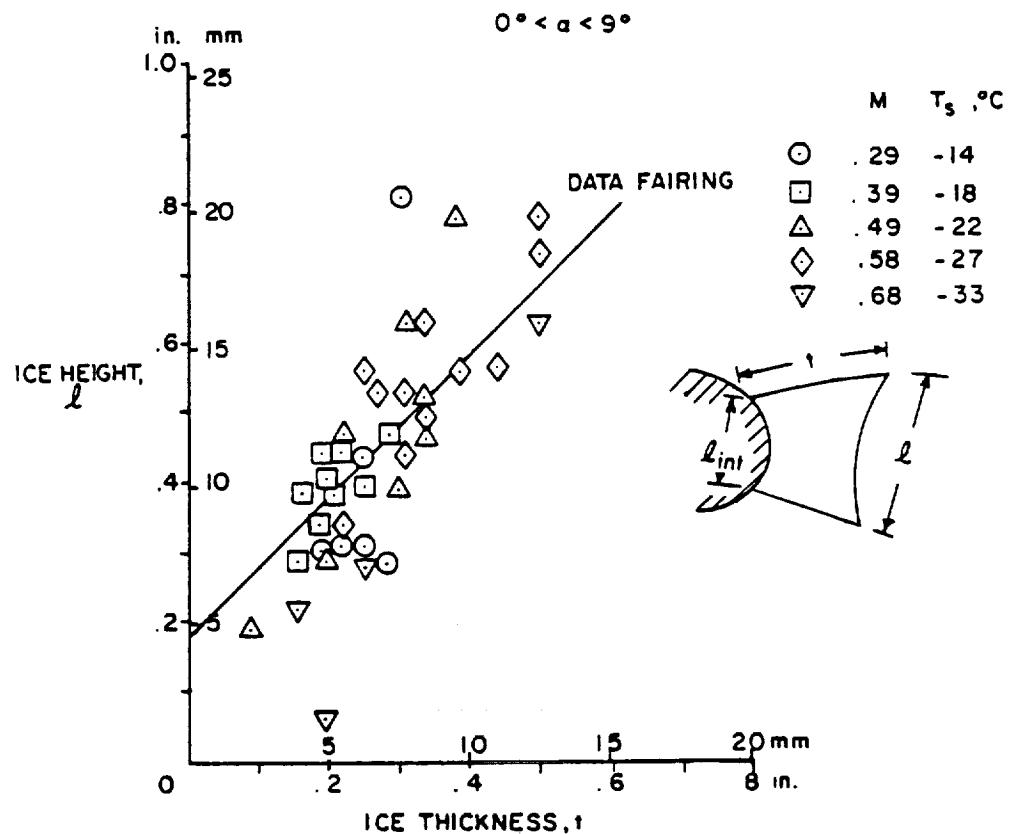
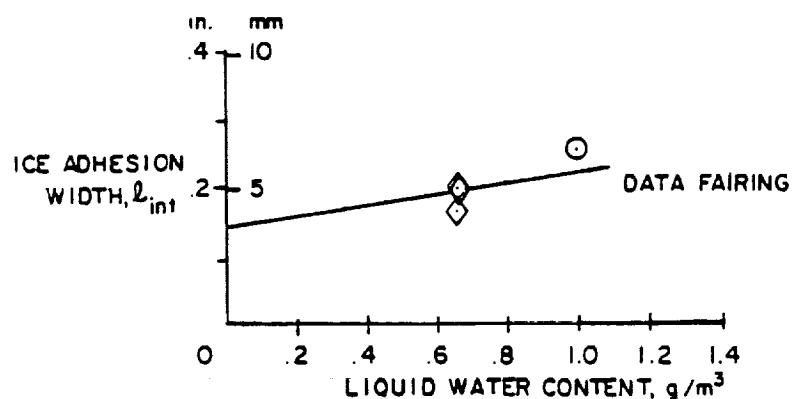
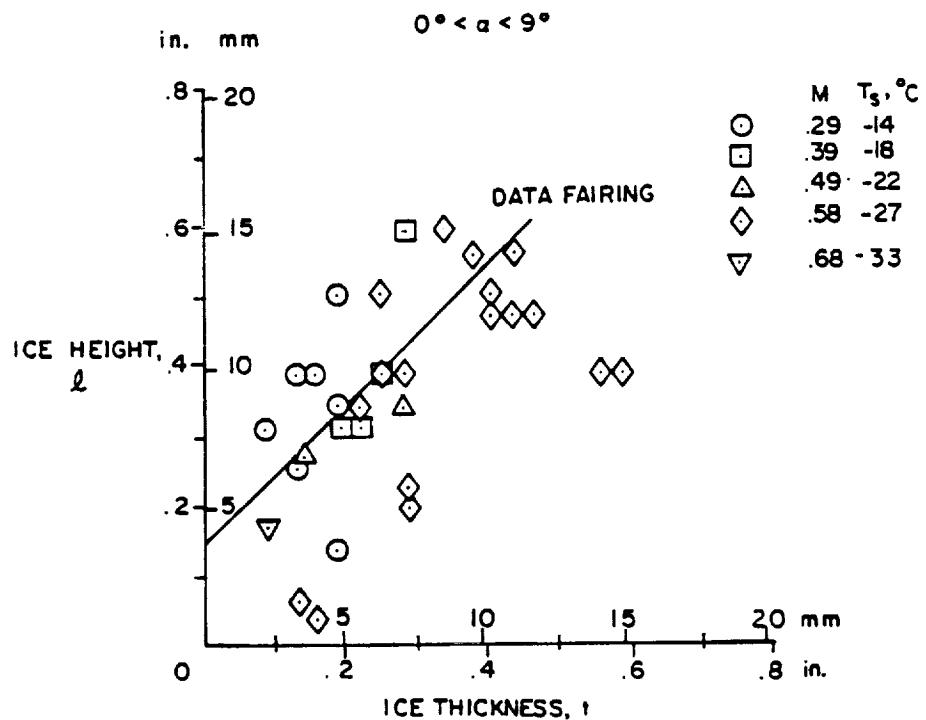


Figure 37. - Circulation control airfoil ice tracings.



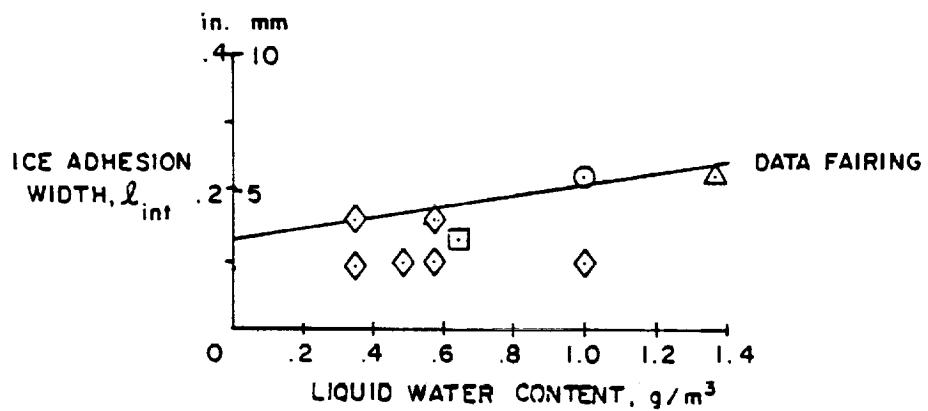
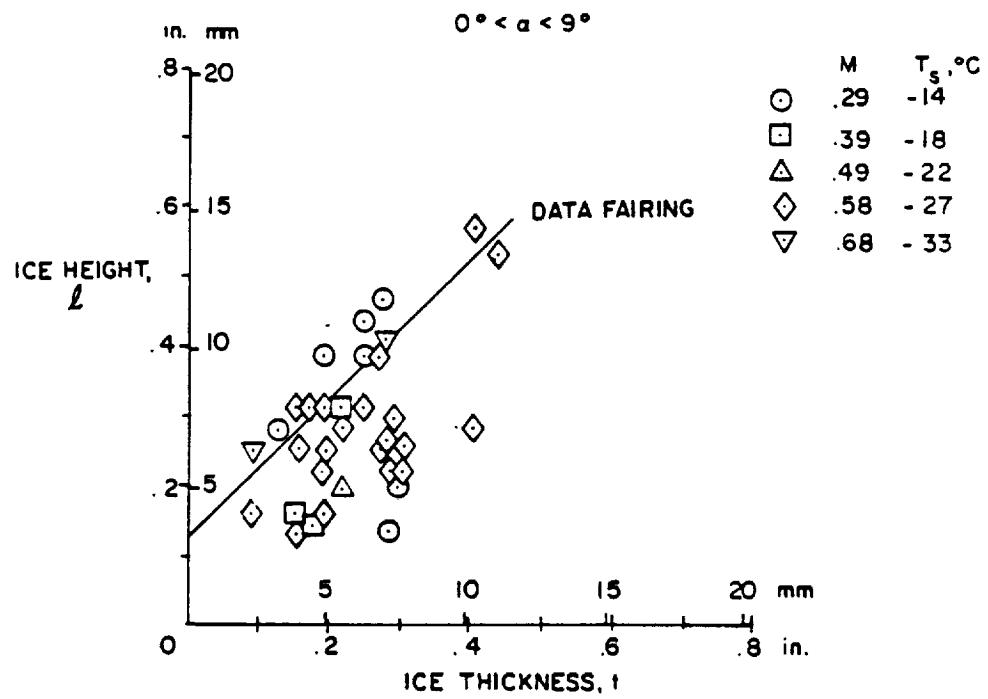
a. NACA 0012

Figure 38. - Ice geometry characteristics.



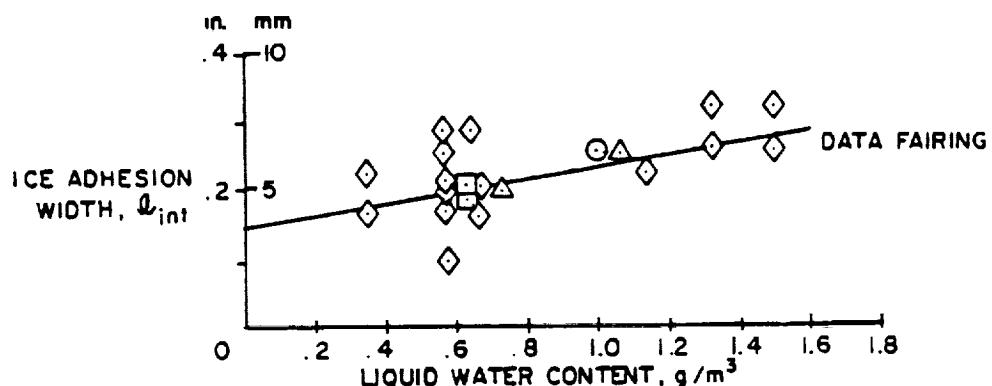
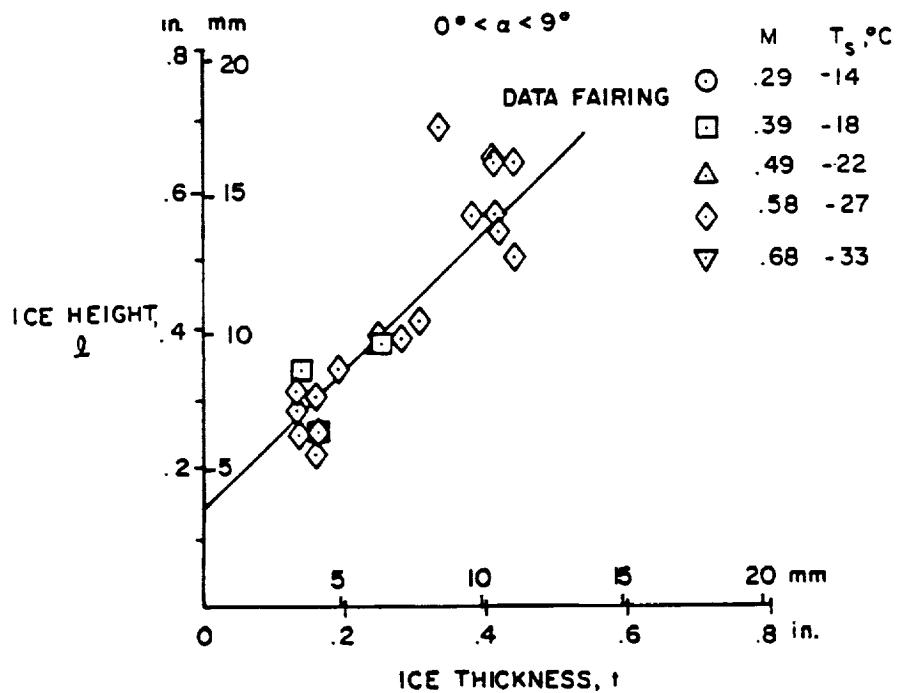
b. SC1095

Figure 38. - (Continued)



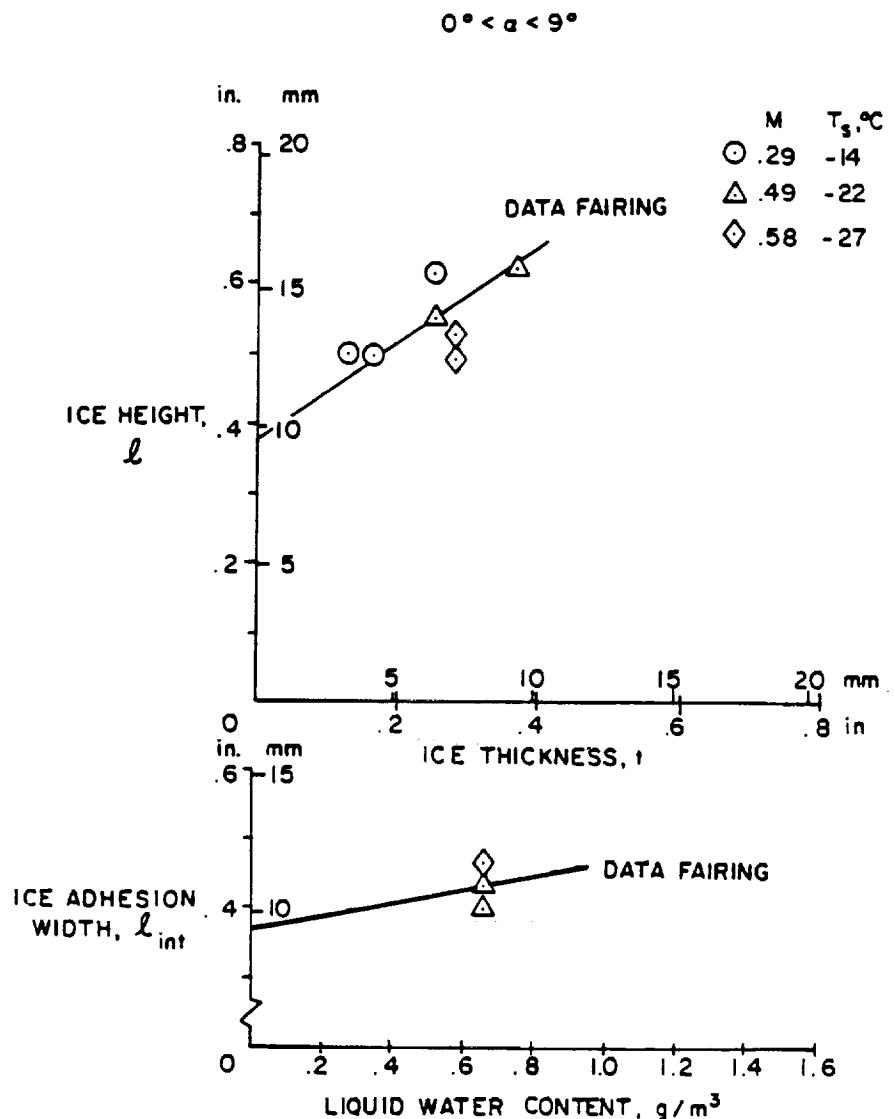
C. SSC-A09

Figure 38. - (Continued)



d. SC1094 R8

Figure 38. - (Continued)



e. Circulation Control

Figure 38. - (Concluded)

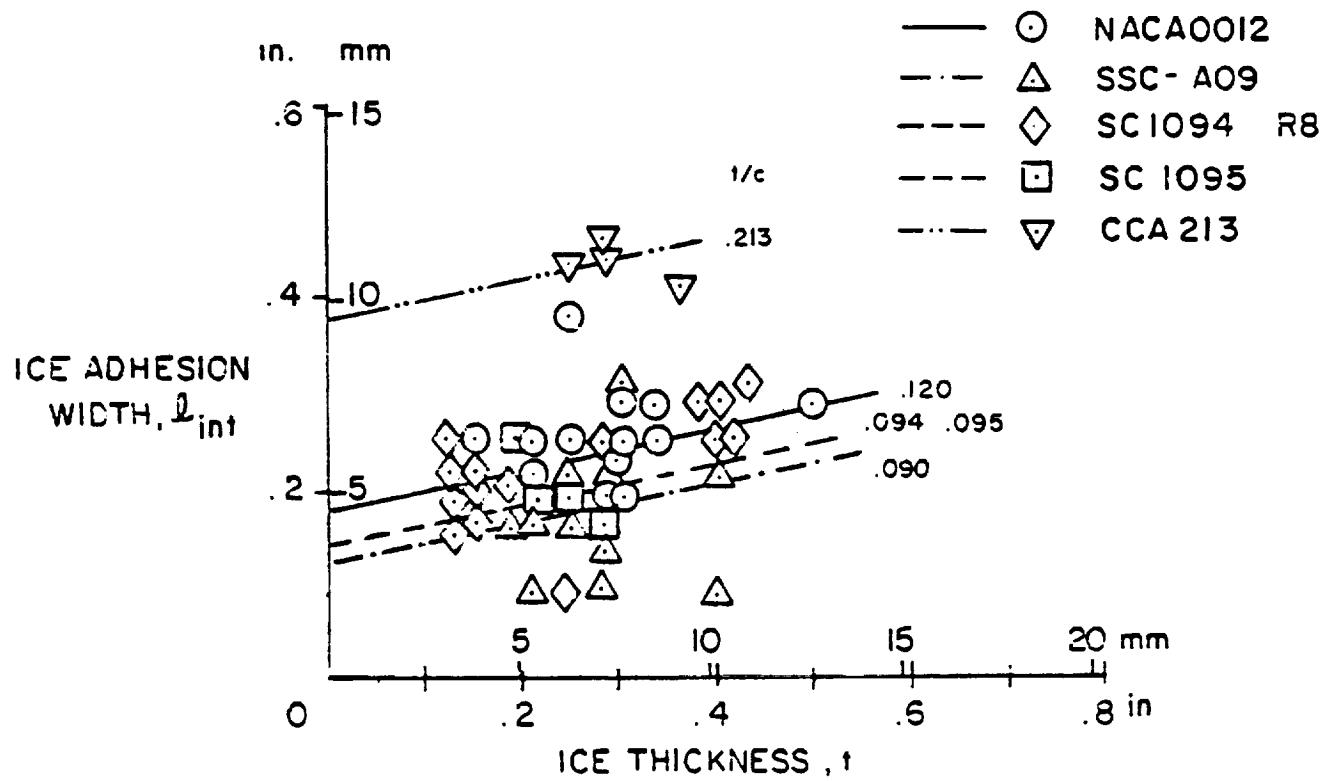


Figure 39. - Ice adhesion width versus ice thickness.

ORIGINAL PAGE IS
OF POOR QUALITY

ORIGINAL PAGE IS
OF POOR QUALITY

----- REFERENCE 13 MINIMUM ICING TEMPERATURE

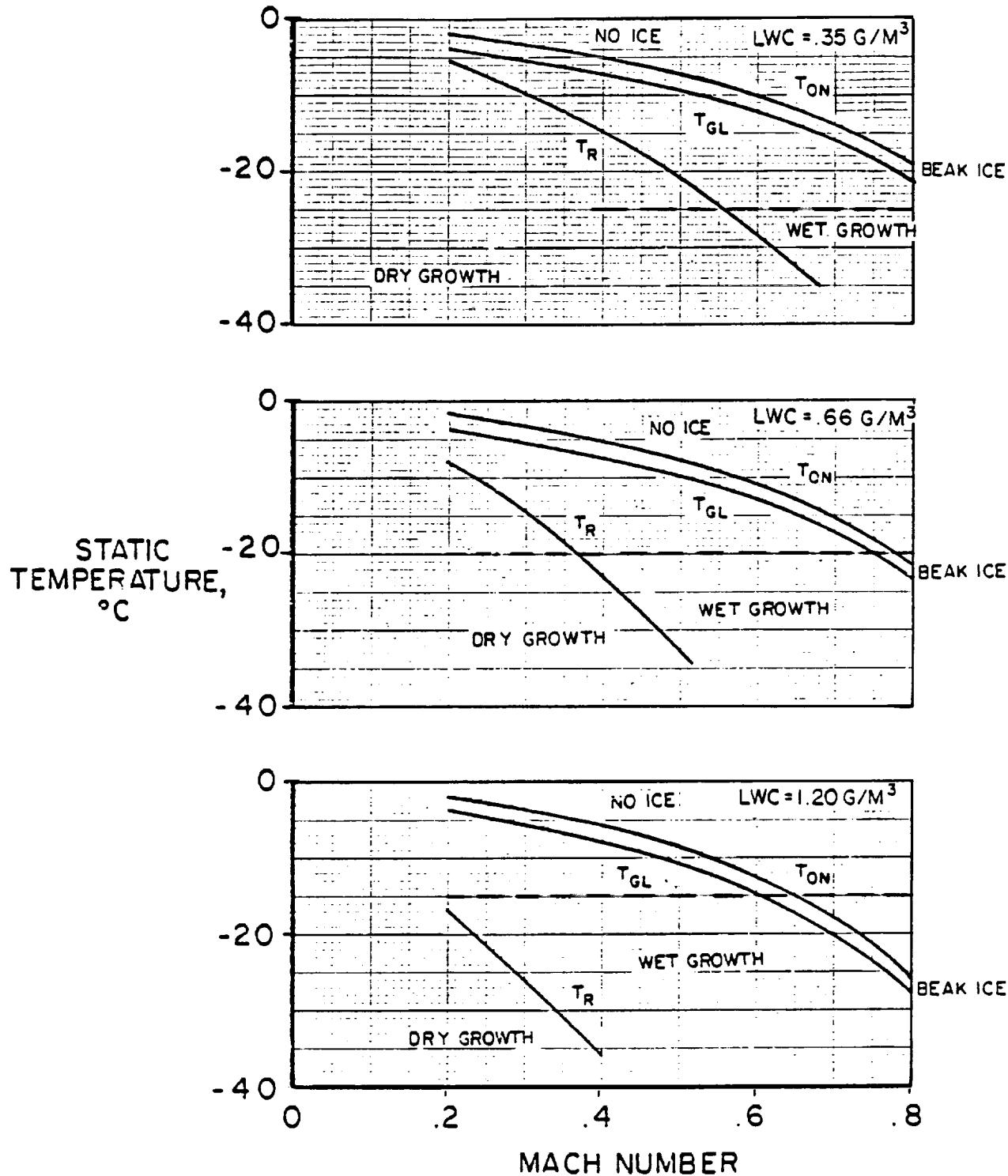


Figure 40. - Ice type boundaries, angle of attack = 6 degrees.

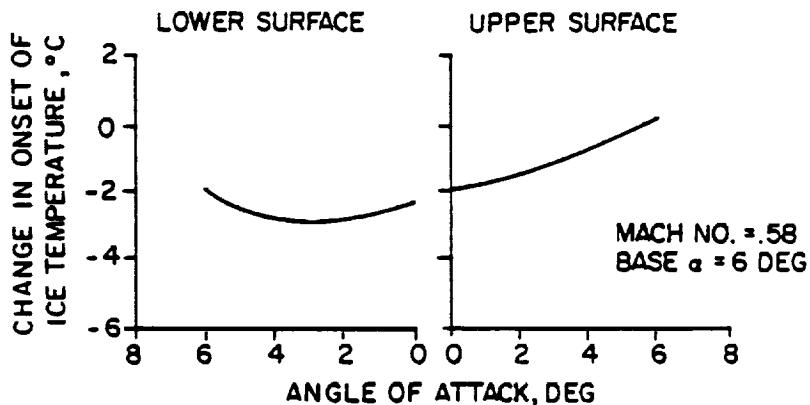


Figure 41. - Onset of ice temperature versus angle of attack.

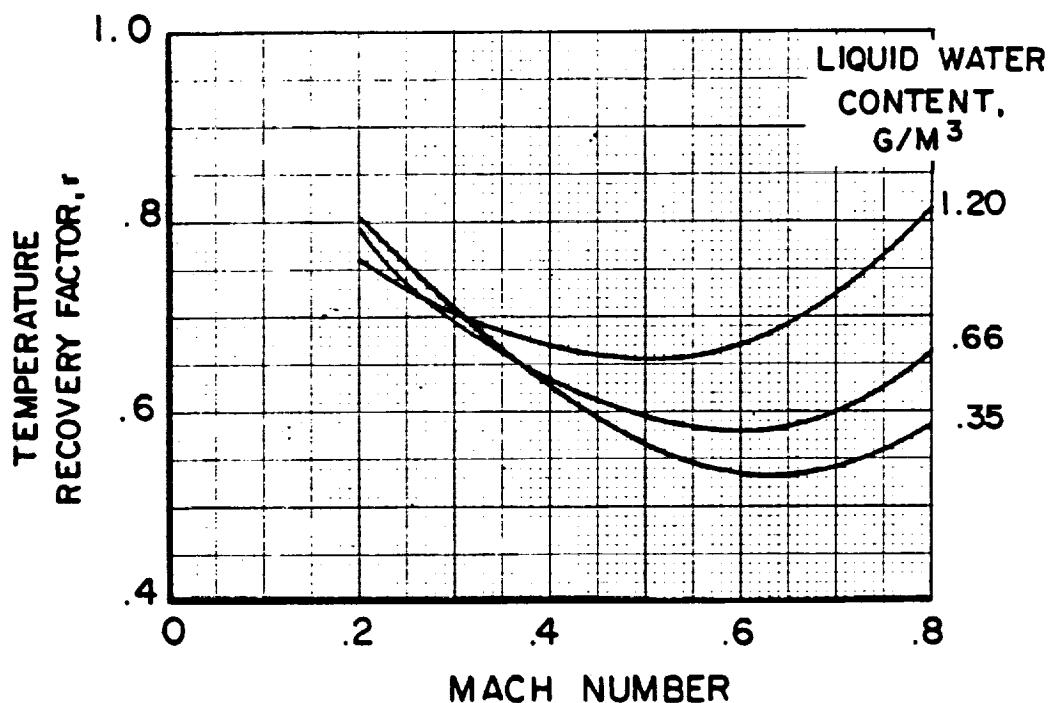


Figure 42. - Temperature recovery factor determined by onset of ice conditions, angle of attack = 6 degrees.

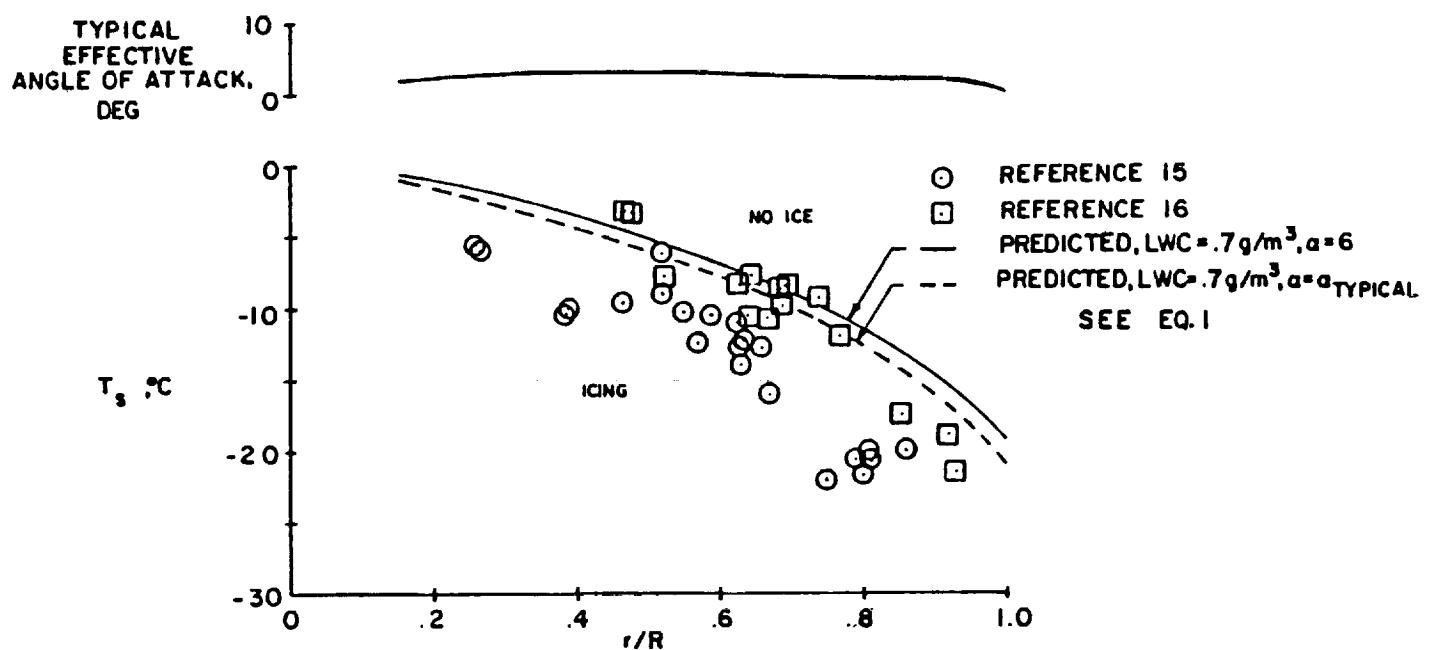


Figure 43. - Icing extent correlation for the JUH-1H helicopter.

CH-53E ICE EXTENT DATA

JAN-MARCH 1984

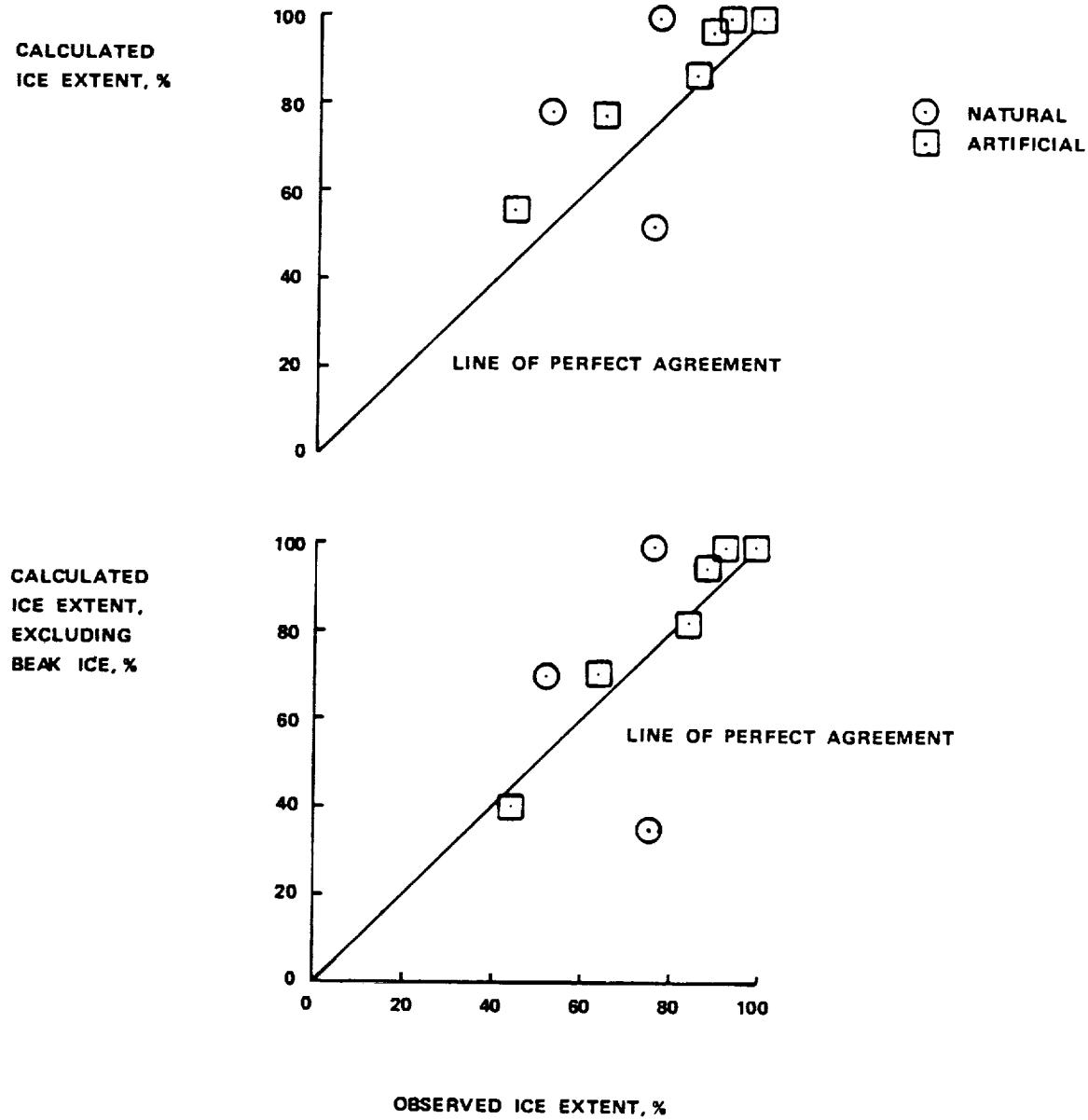


Figure 44. - Icing extent correlation for the CH-53E helicopter.

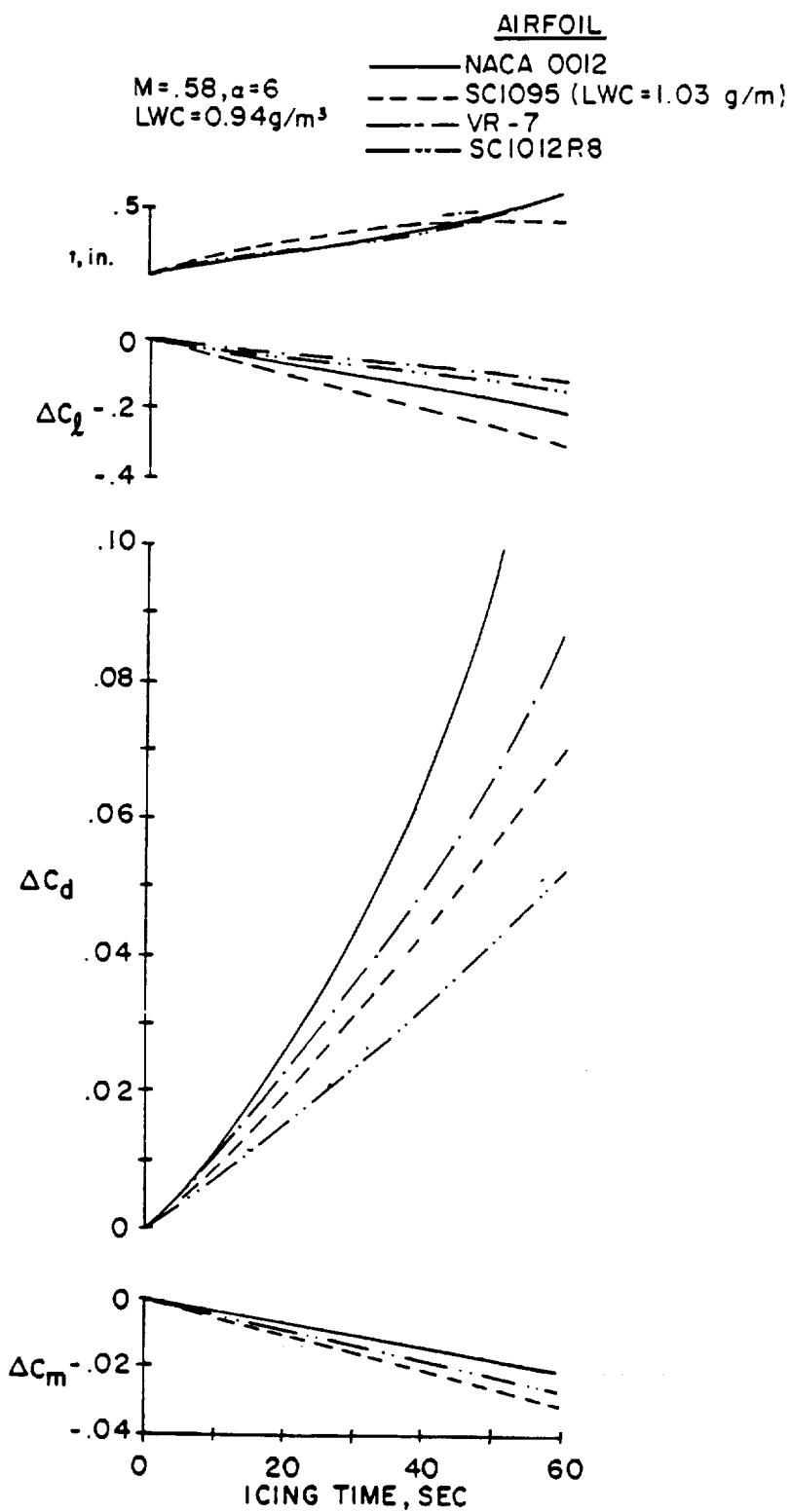


Figure 45. - Effect of icing time at an angle of attack of 6 degrees at high Mach numbers.

$M = 0.49$, $\alpha = 6^\circ$, $LWC = 0.94 \text{ g/m}^3$, $T_s = 22^\circ\text{C}$

SUCTION PEAK

ICING TIME	C_l	C_d	C_m	t	MAX C_p
0 SEC	0.73	.0142	0	0 IN	-2.62
20 SEC	0.67	.0349	-.002	.09 IN	-2.54
45 SEC	0.54	.0923	-.012	.19 IN	-1.56
60 SEC	0.52	.1224	-.033	.34 IN	-1.35

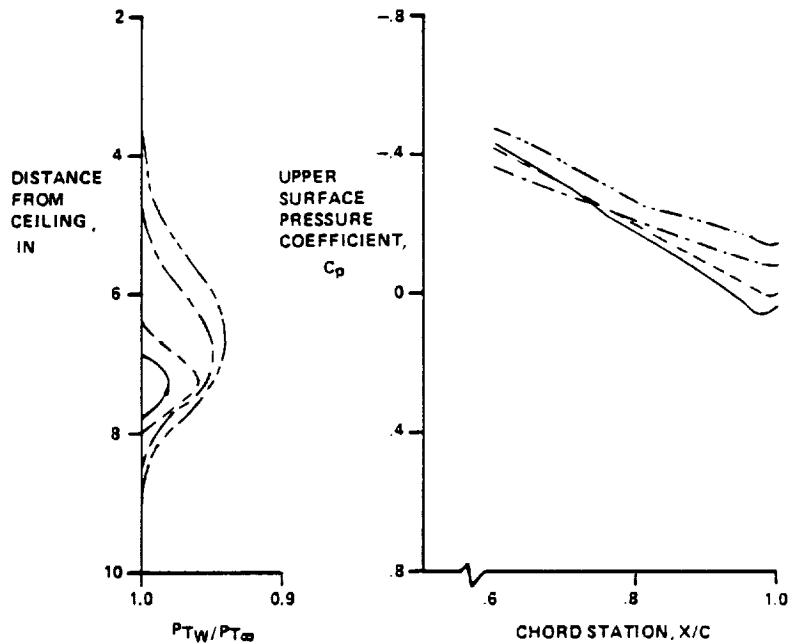


Figure 46. - Impact of ice accretion time on the NACA 0012 airfoil pressures.

$M = 0.58, \alpha = 6^\circ, LWC = 1.03 \text{ g/m}^3, T_s = -27^\circ\text{C}$

SUCTION PEAK

ICING TIME	<u>C_I</u>	<u>C_d</u>	<u>C_m</u>	<u>t</u>	MAX <u>C_p</u>
0 SEC	.96	.0370	-.019	0 IN	-2.62
20 SEC	.93	.0371	-.023	.25 IN	-2.53
45 SEC	.72	.0642	-.048	.38 IN	-2.30
60 SEC	.67	.0811	-.050	.59 IN	-1.83

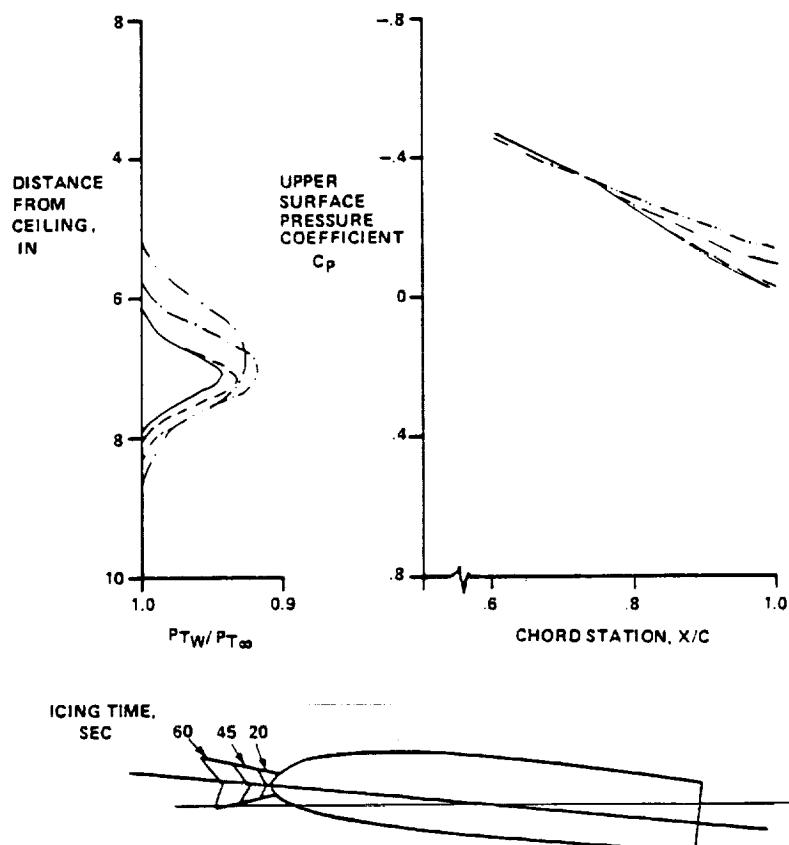


Figure 47. - Impact of ice accretion time on the SC1095 airfoil pressures.

$M = .59$, $\alpha = 6^\circ$, $LWC = .85 \text{ g/m}^3$, $T_s = -27^\circ\text{C}$

SUCTION PEAK

ICING TIME	C_l	C_d	C_m	t	MAX C_p
0 SEC	.97	.0280	-.019	.0 IN	-2.460
30 SEC	.81	.0384	-.037	.28 IN	-2.423
45 SEC	.79	.0547	-.040	.27 IN	-2.319

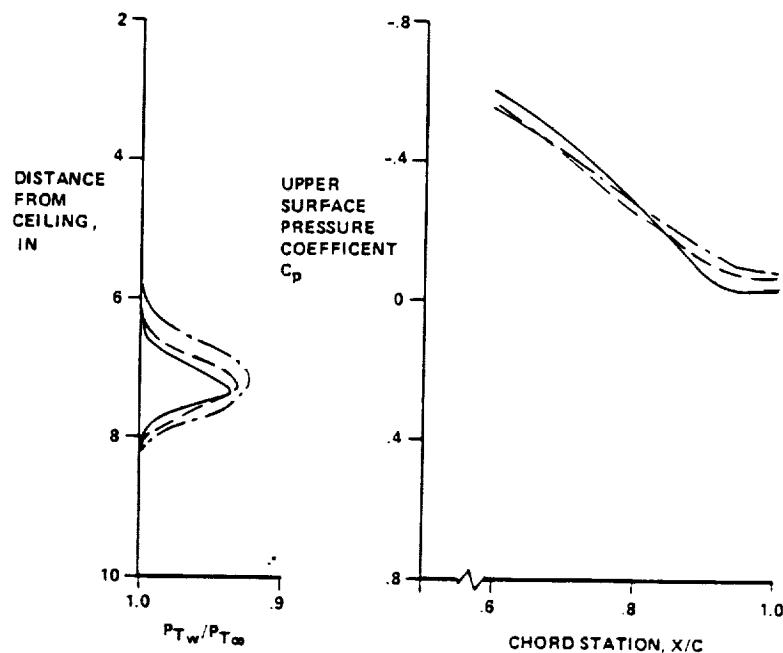


Figure 48. - Impact of ice accretion time on the SSC-A09 airfoil pressures.

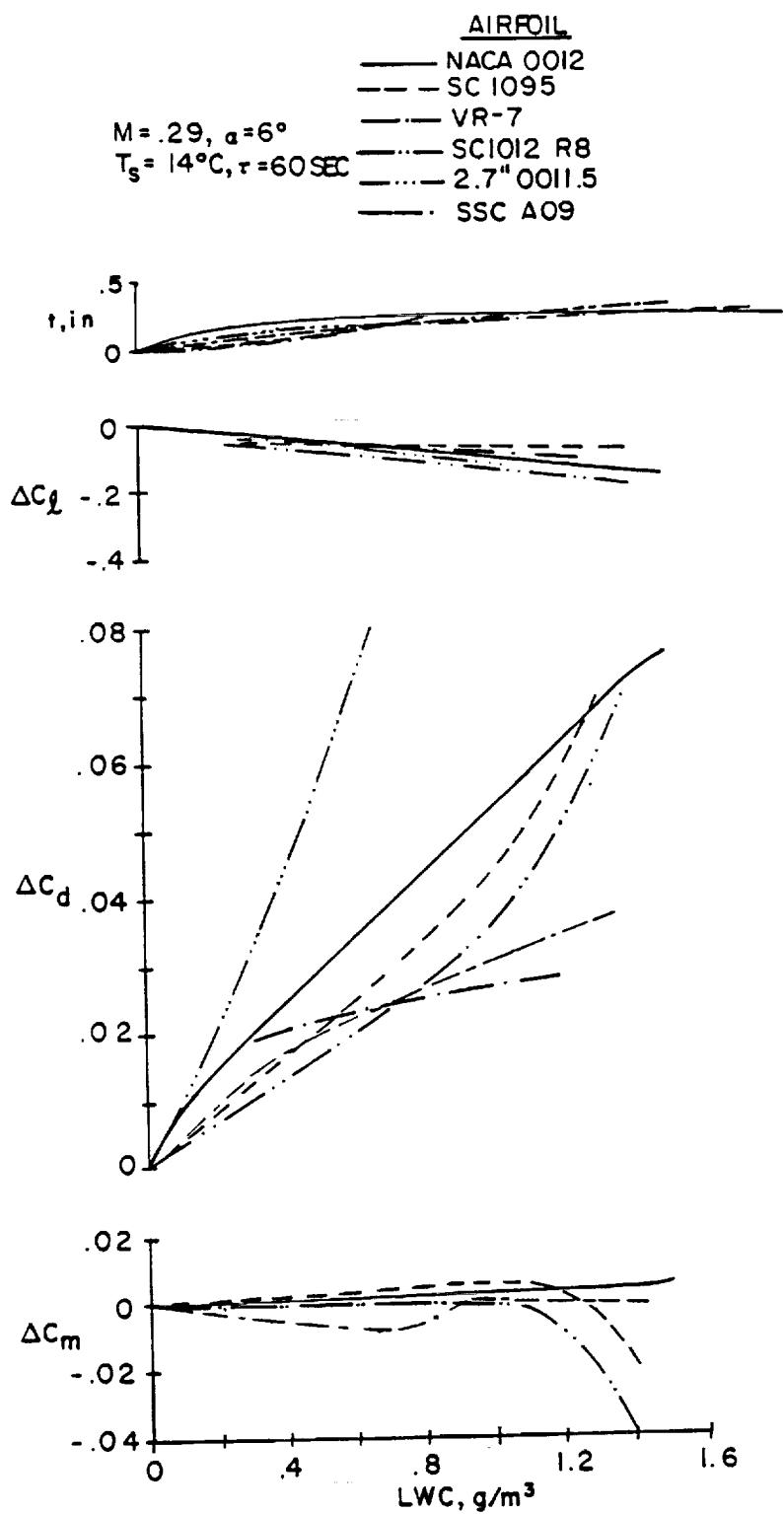


Figure 49. - Summary of the effect of liquid water content on force and moment coefficients, Mach number = 0.29.

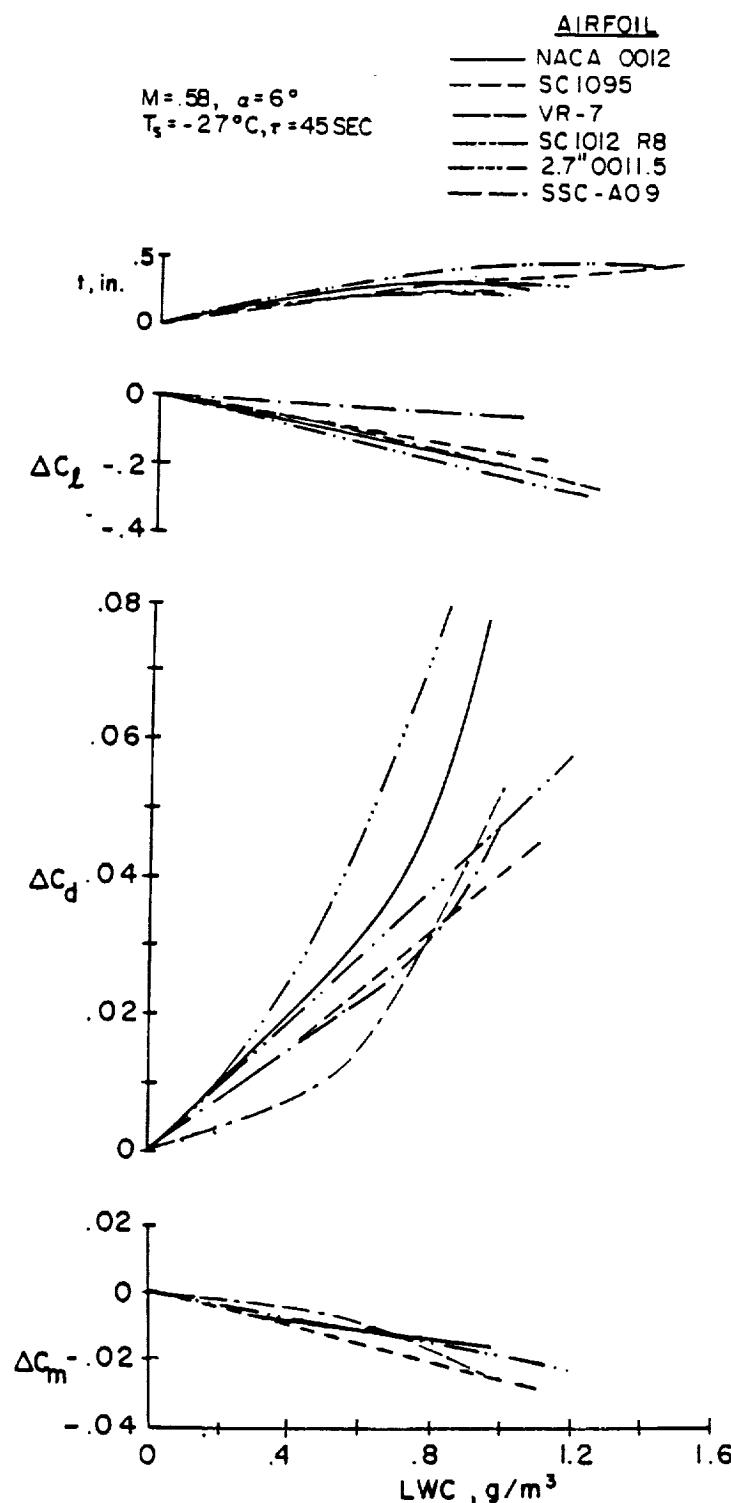


Figure 50. - Summary of the effect of liquid water content on force and moment coefficients, Mach number = 0.58.

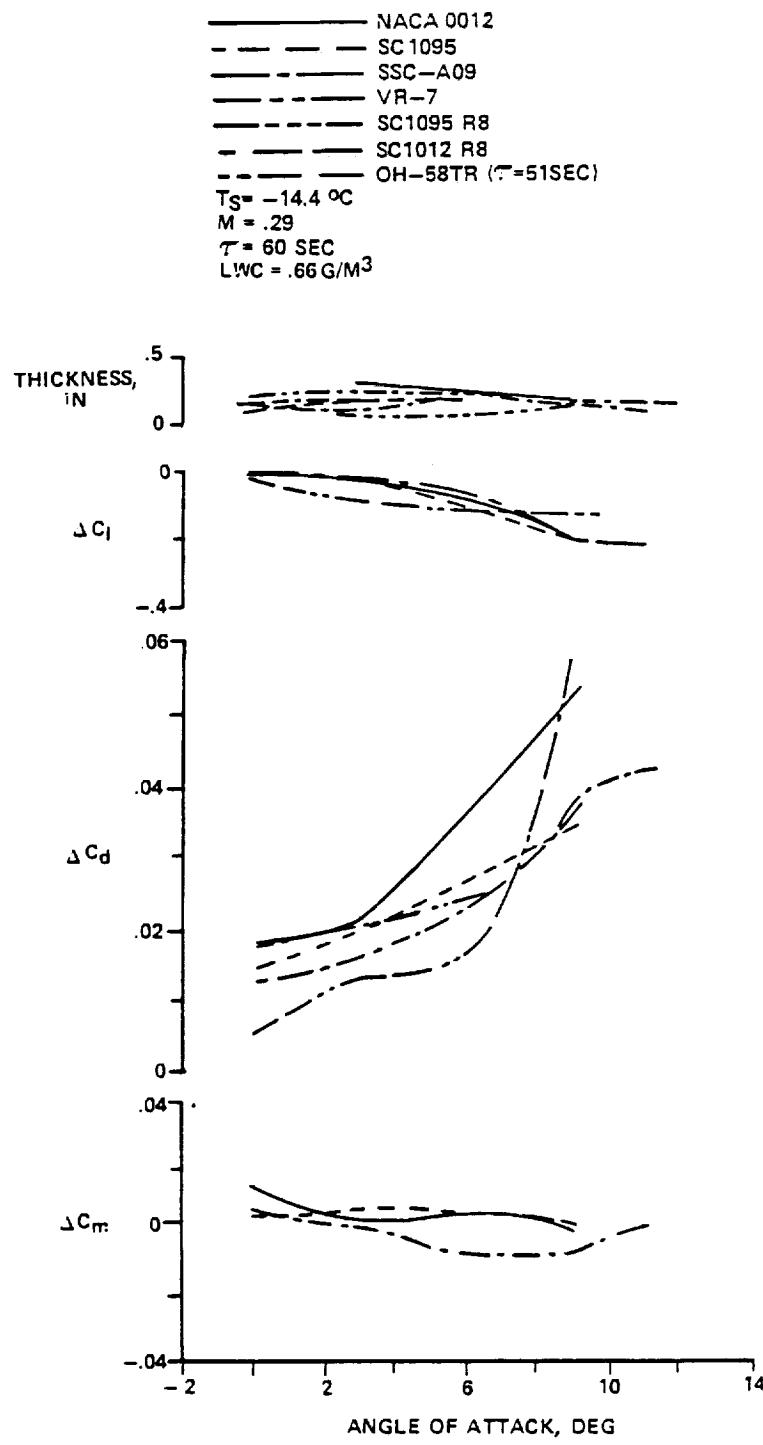


Figure 51. - Summary of the effects of angle of attack on force and moment coefficients, Mach number = 0.29.

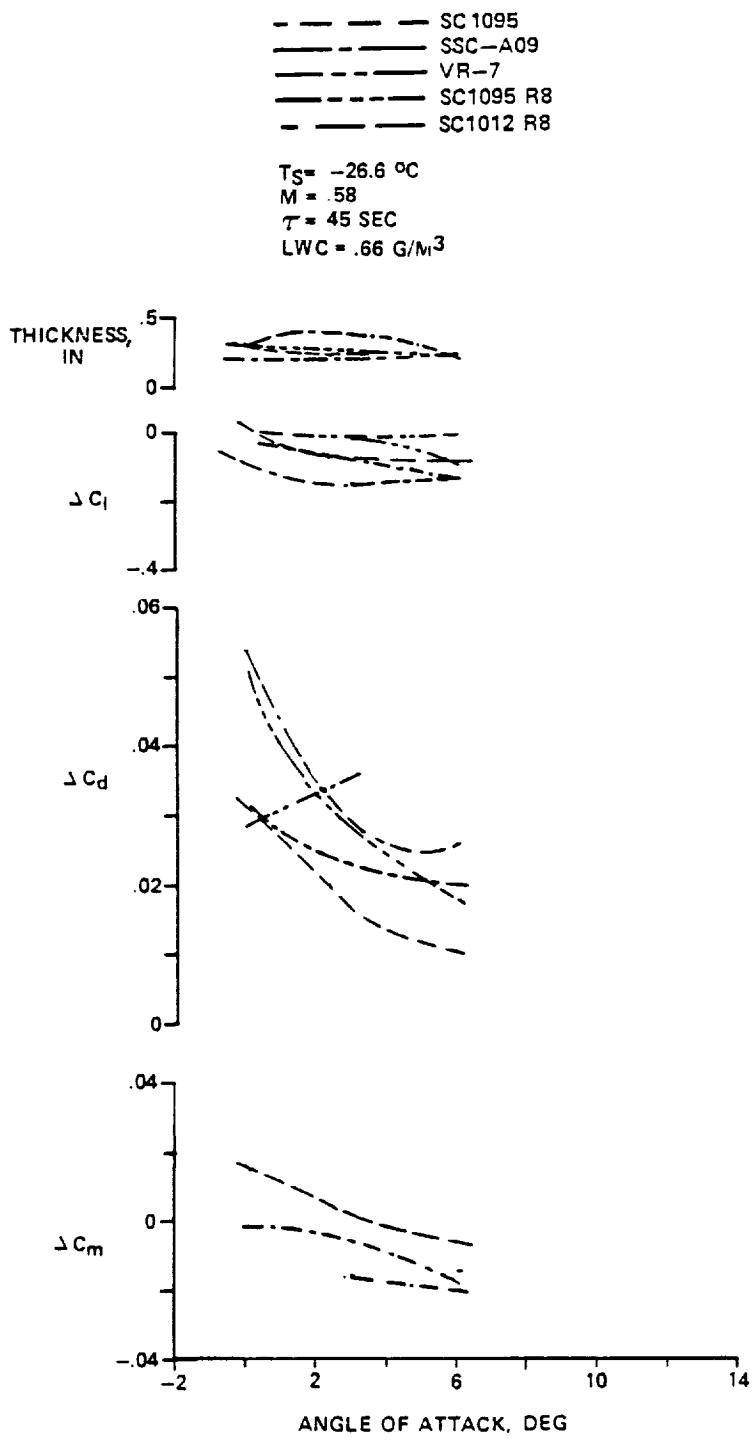


Figure 52. - Summary of the effect of angle of attack on force and moment coefficients, Mach number = 0.58.

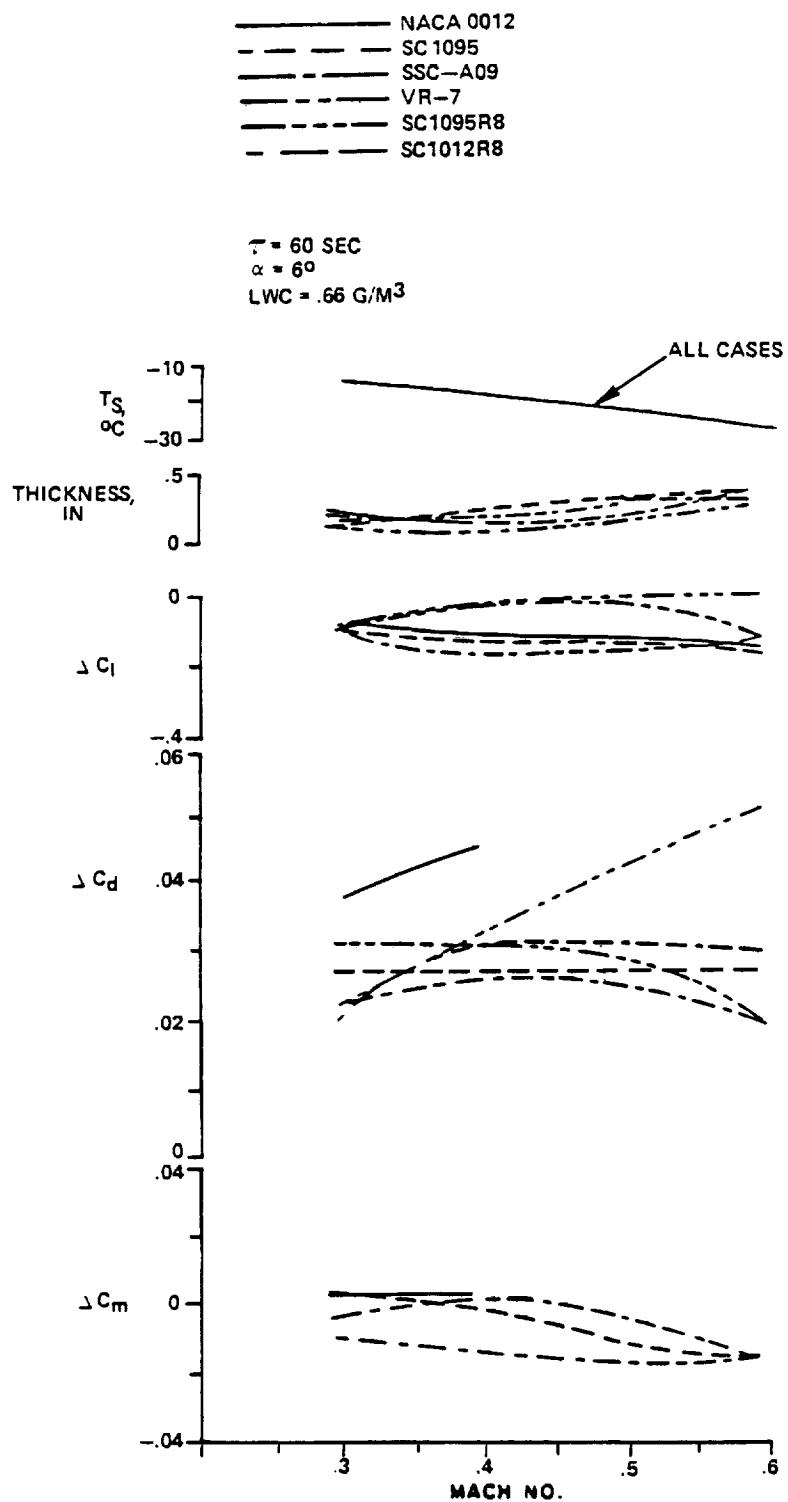


Figure 53. - Summary of the effect of Mach number on force and moment coefficients, angle of attack = 6 degrees.

PREDICTED	TEST	AIRFOIL	M	α , DEG	τ , SEC	T °C	LWC, g/m³
—	○ SC1012 R8	.29	6	60	-14	.66	
- - -	□ SC1012 R8	.58	6	45	-27	.58	
— · —	● SC1094 R8	.58	6	—	—	—	.58

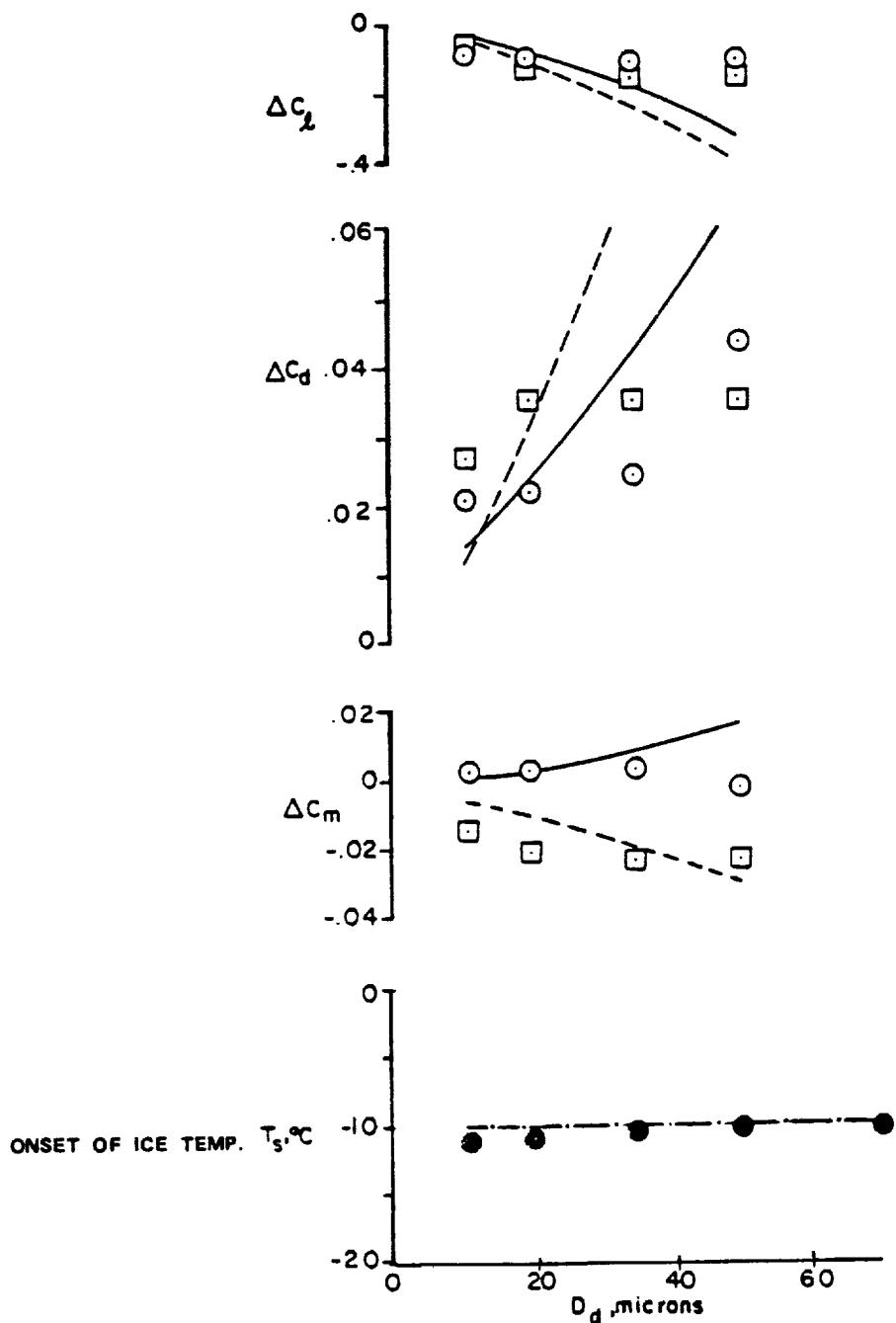
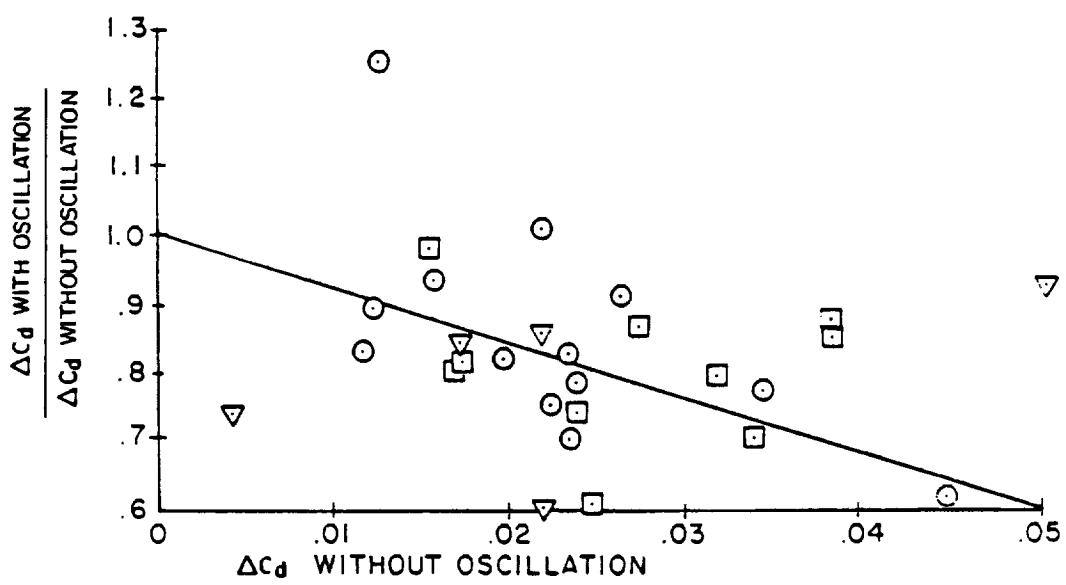
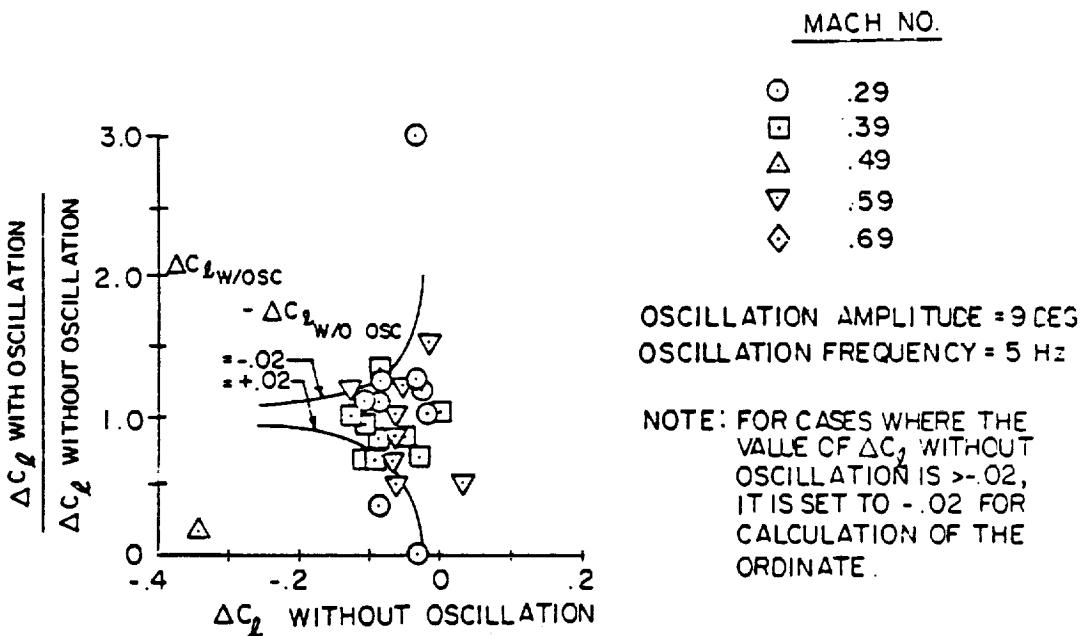
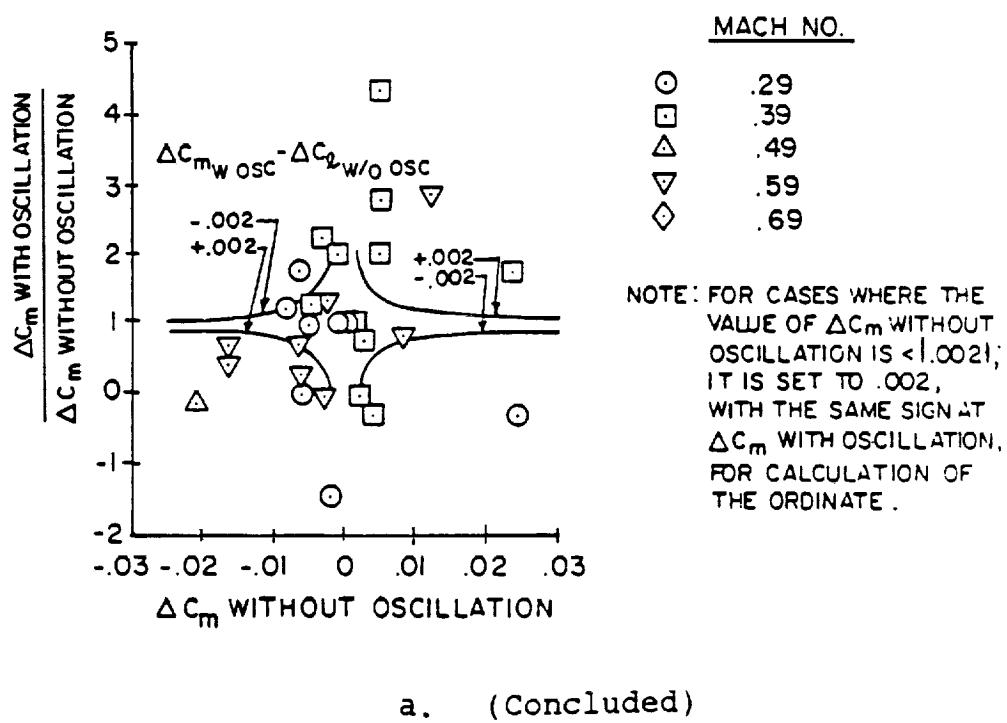


Figure 54. - Summary of the effect of mean volume droplet diameter on force and moment coefficients.



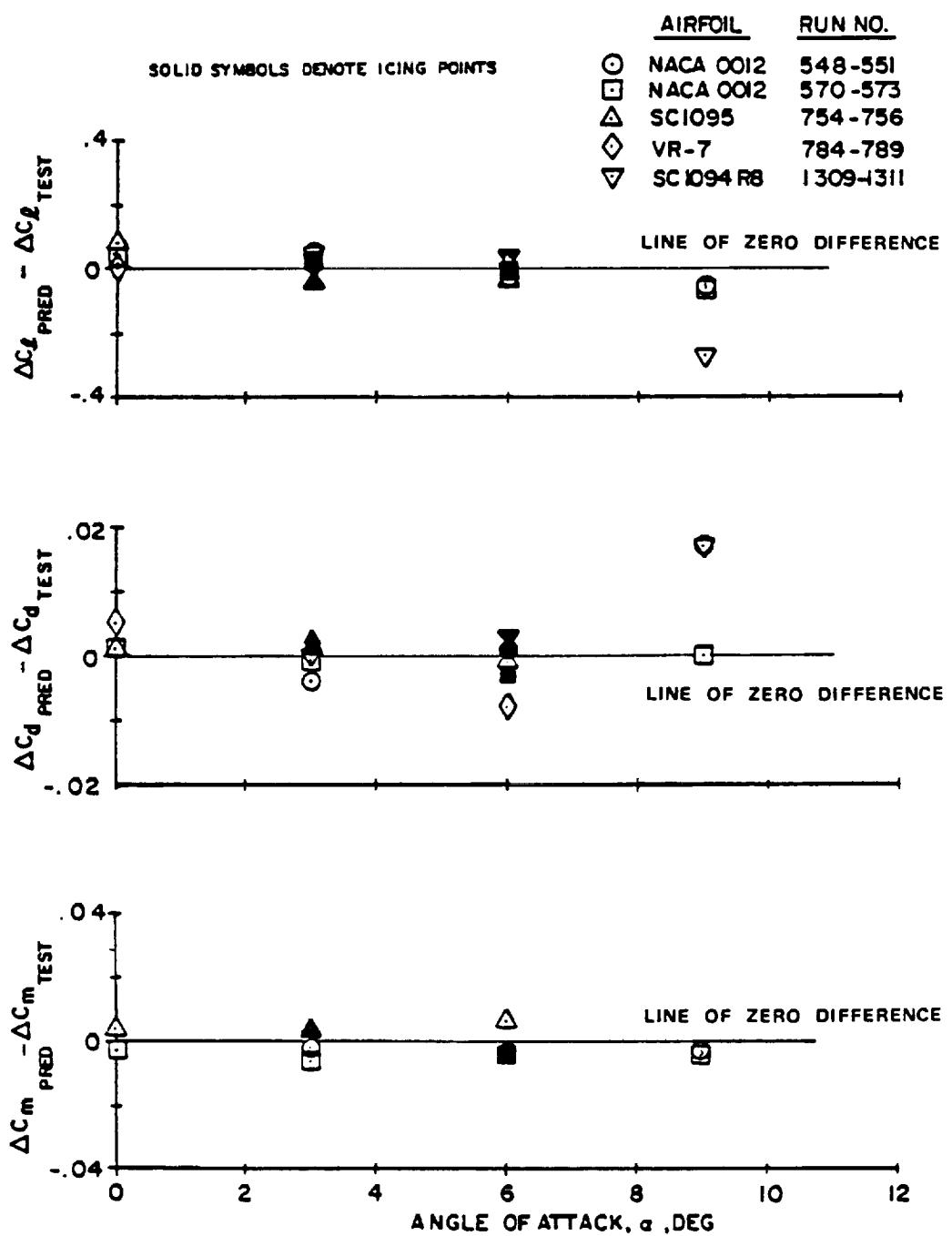
a. Effect of airfoil oscillation

Figure 55. - Effect of airfoil oscillation and angle of attack changes on force and moment coefficients.



a. (Concluded)

Figure 55. - (Continued)



b. Effect of angle of attack changes

Figure 55. - (Concluded)

PREDICTED	TEST	AIRFOIL	MACH NO.	LWC (G/M ³)	TIME (SEC)
-----------	------	---------	----------	----------------------------	---------------

—	○	SC1095	.58	.66	45
—	□	NACA0012	.58	.66	45
—	△	SSC-A09	.58	.35	45
—	△	SSC-A09	.58	.66	45
- - -	◊	SC1012 R8	.29	1.00	60

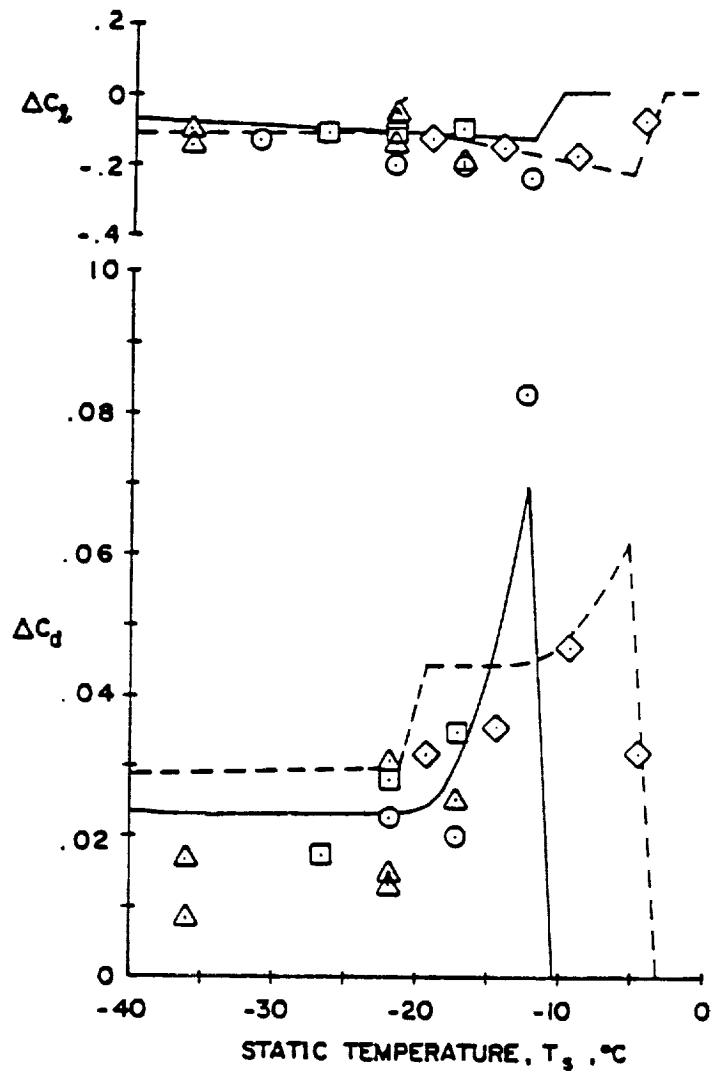


Figure 56. - Effect of static temperature on the drag coefficient.

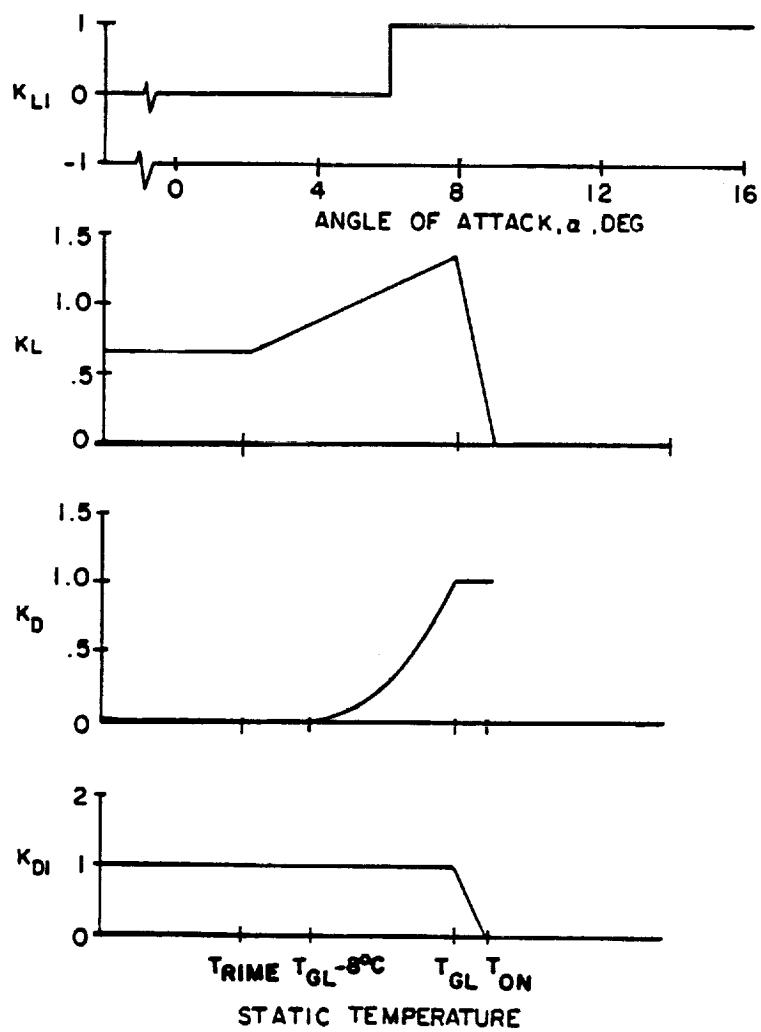


Figure 57. - Temperature and angle of attack factors.

ORIGINAL DATA
OF POOR QUALITY

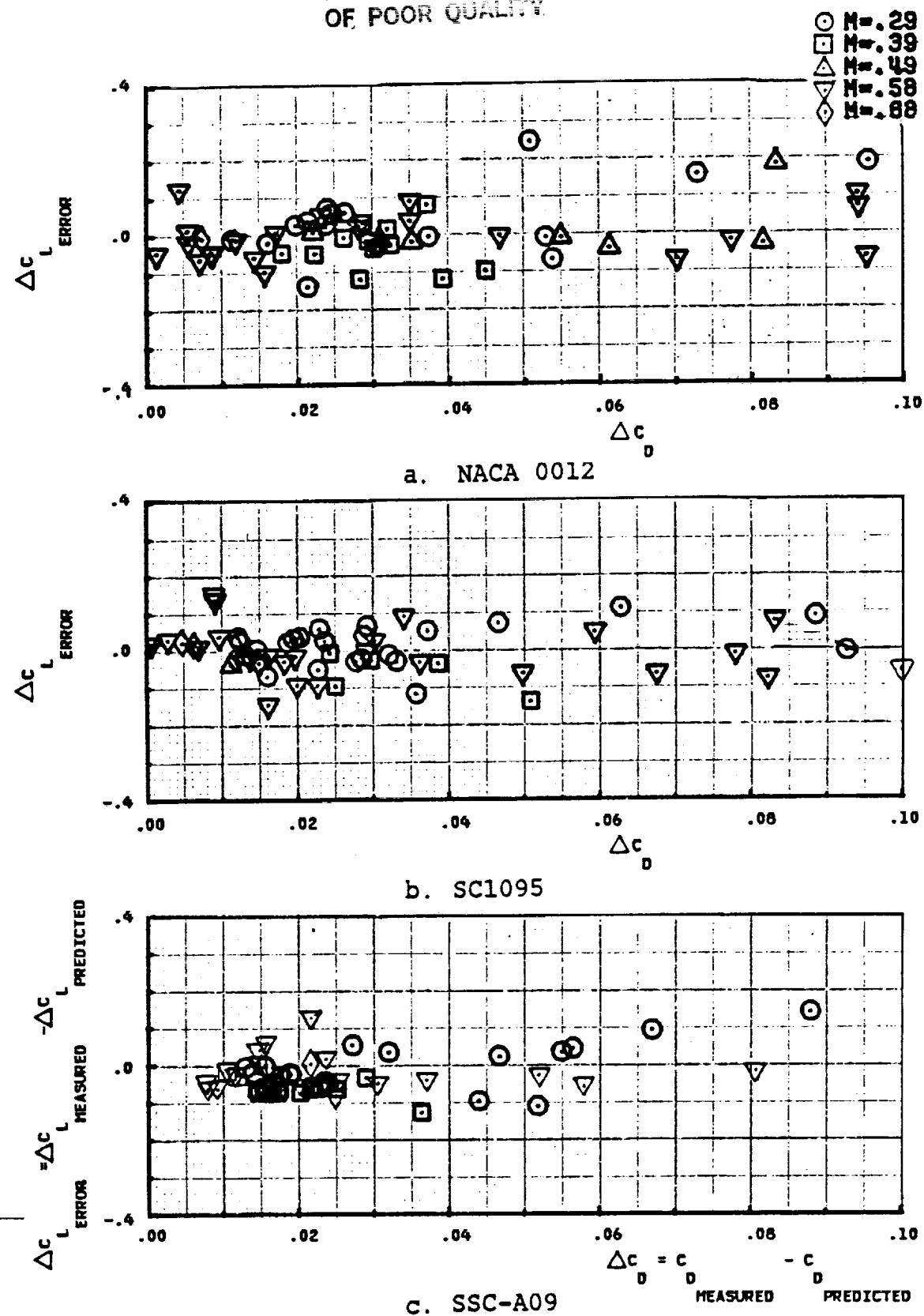
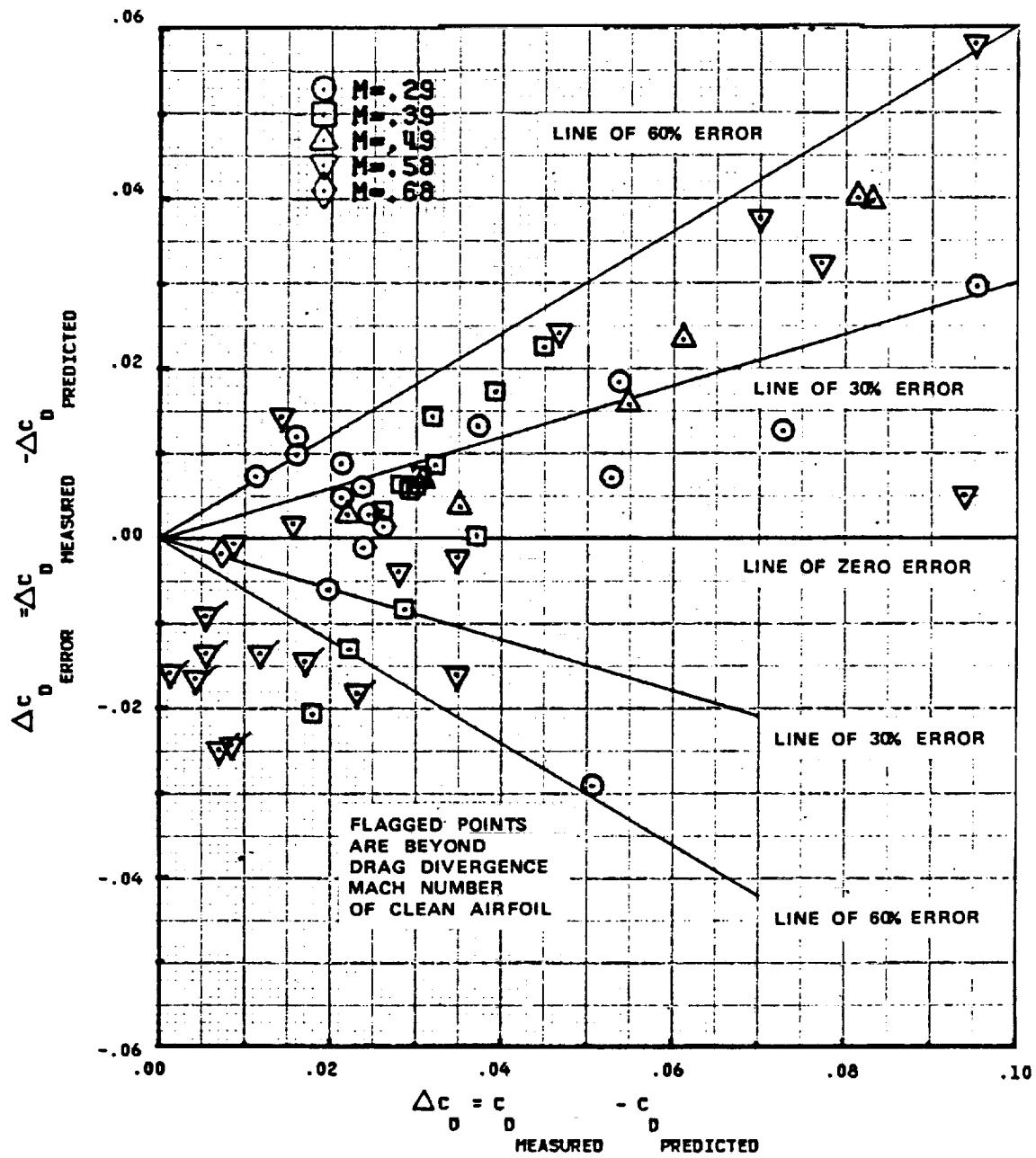


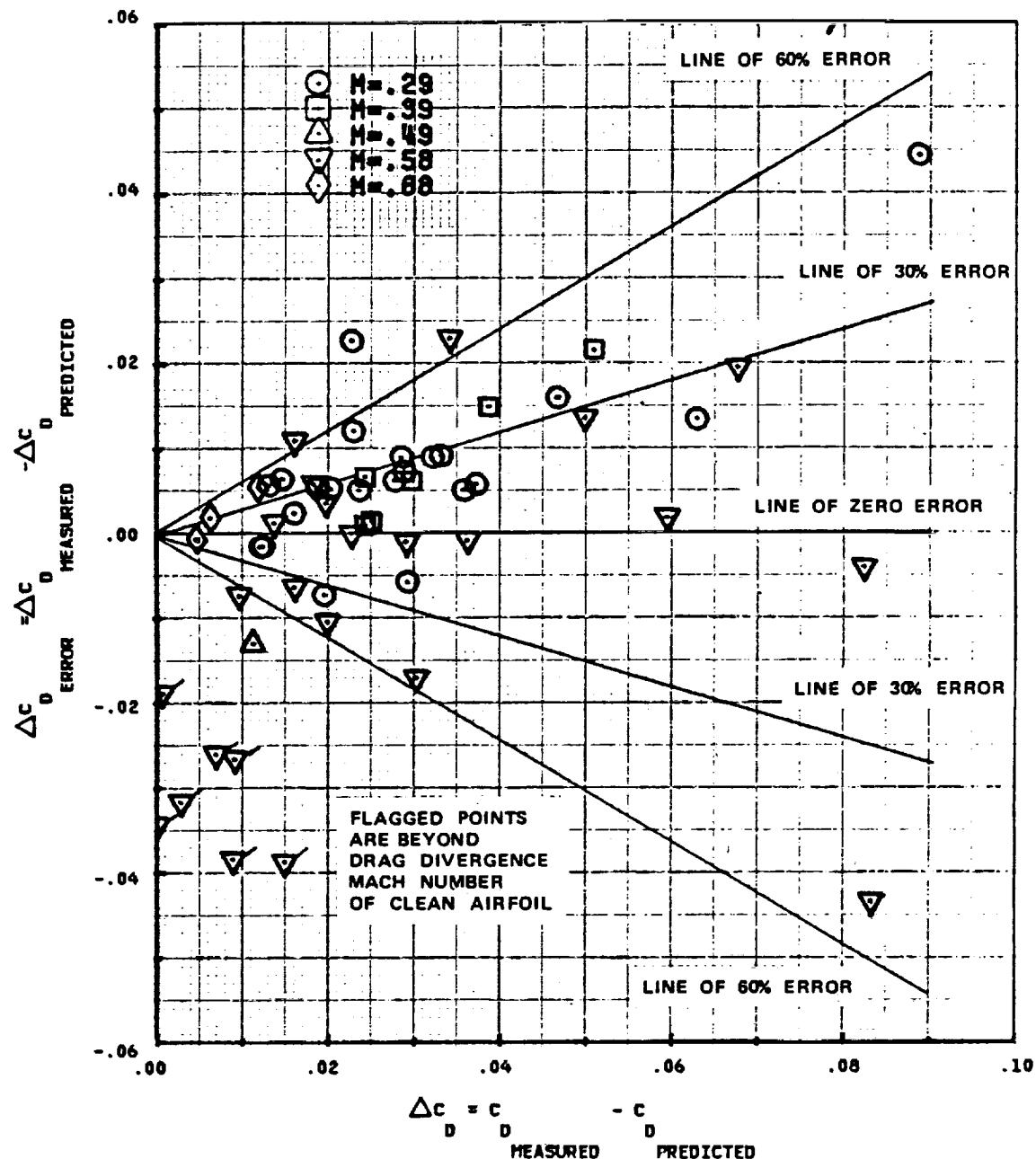
Figure 58. - Correlation of incremental lift relationship with NRC data.

ORIGINAL PAGE IS
OF POOR QUALITY



a. NACA 0012

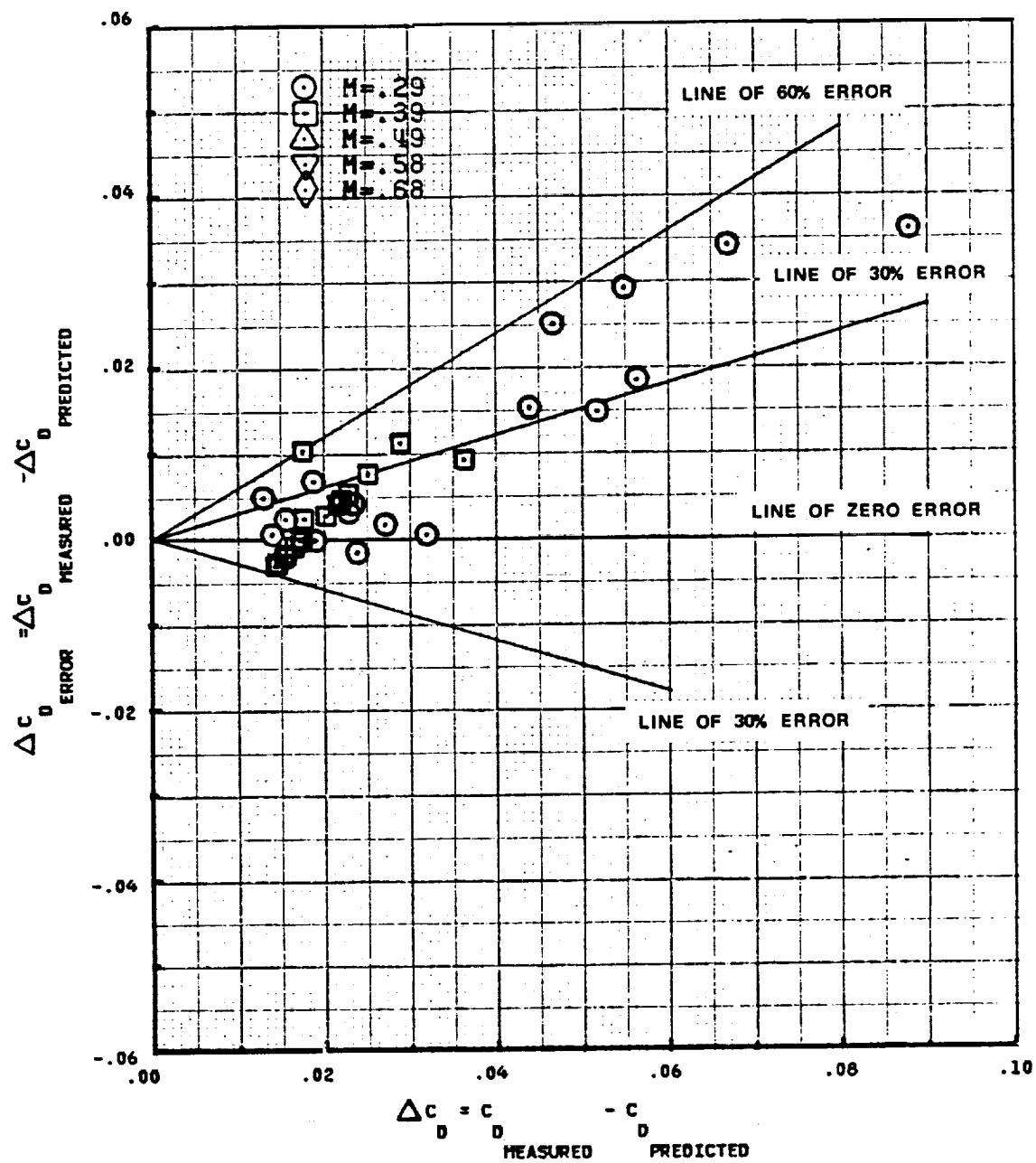
Figure 59. - Correlation of incremental drag relationship with NRC data.



b. SCI1095

Figure 59. - (Continued)

ORIGINAL PAGE IS
OF POOR QUALITY



C. SSC-A09

Figure 59. - (Concluded)

ORIGINAL PAGE --
OF POOR QUALITY

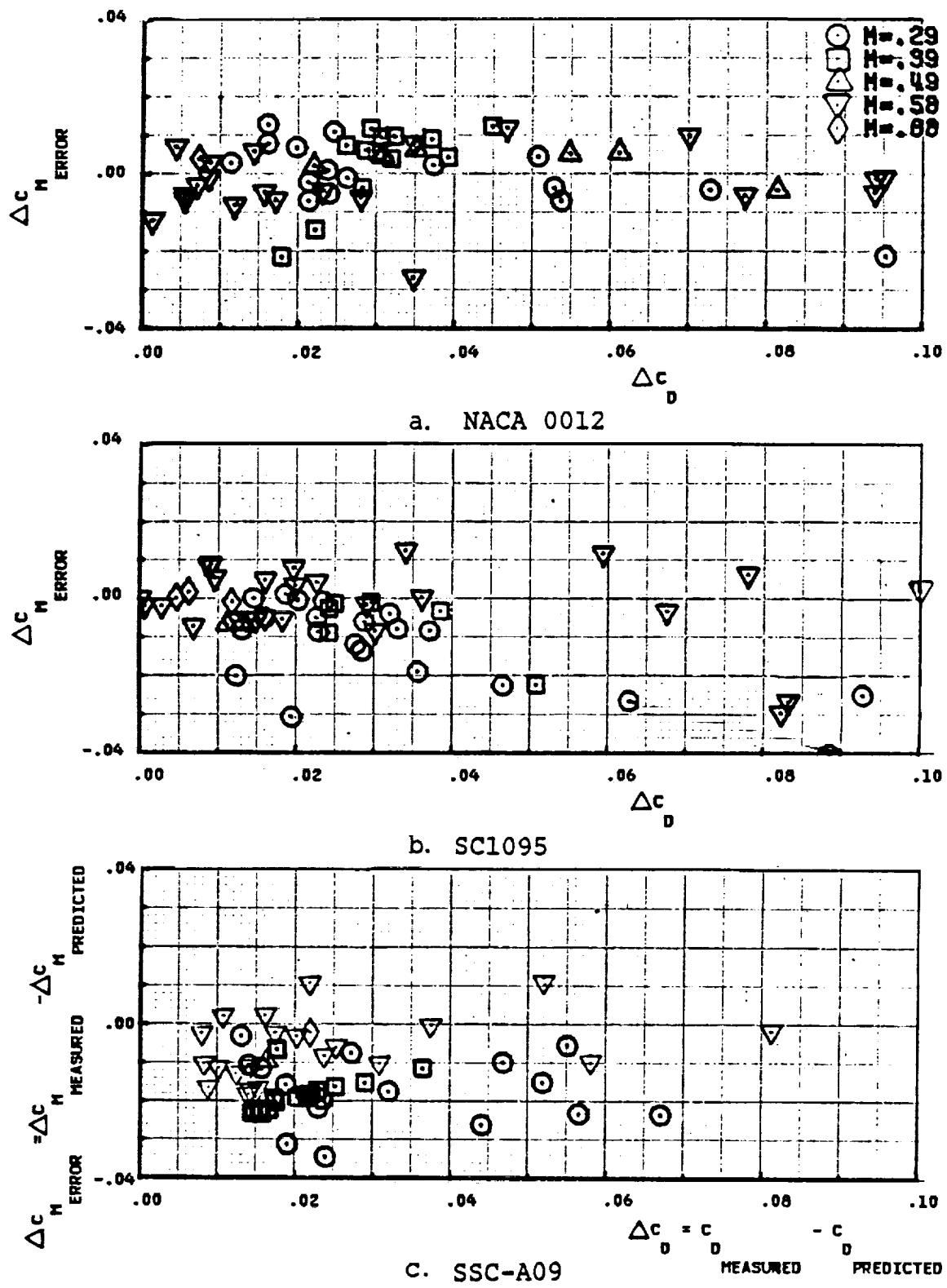
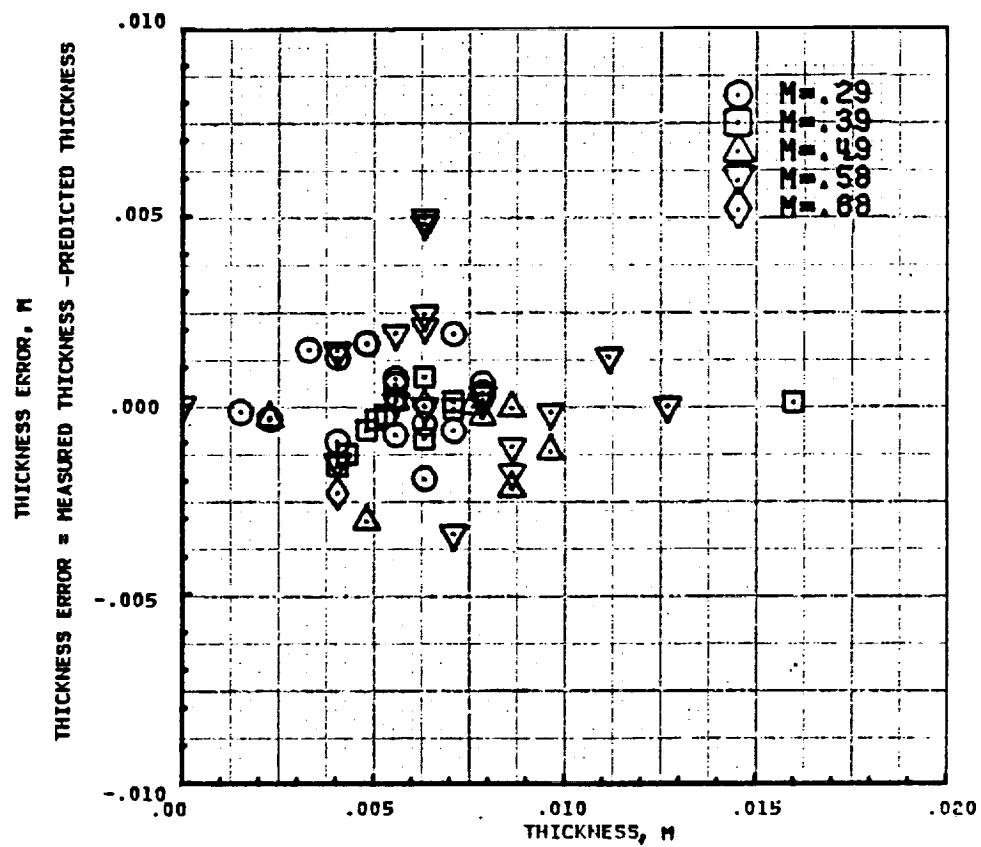


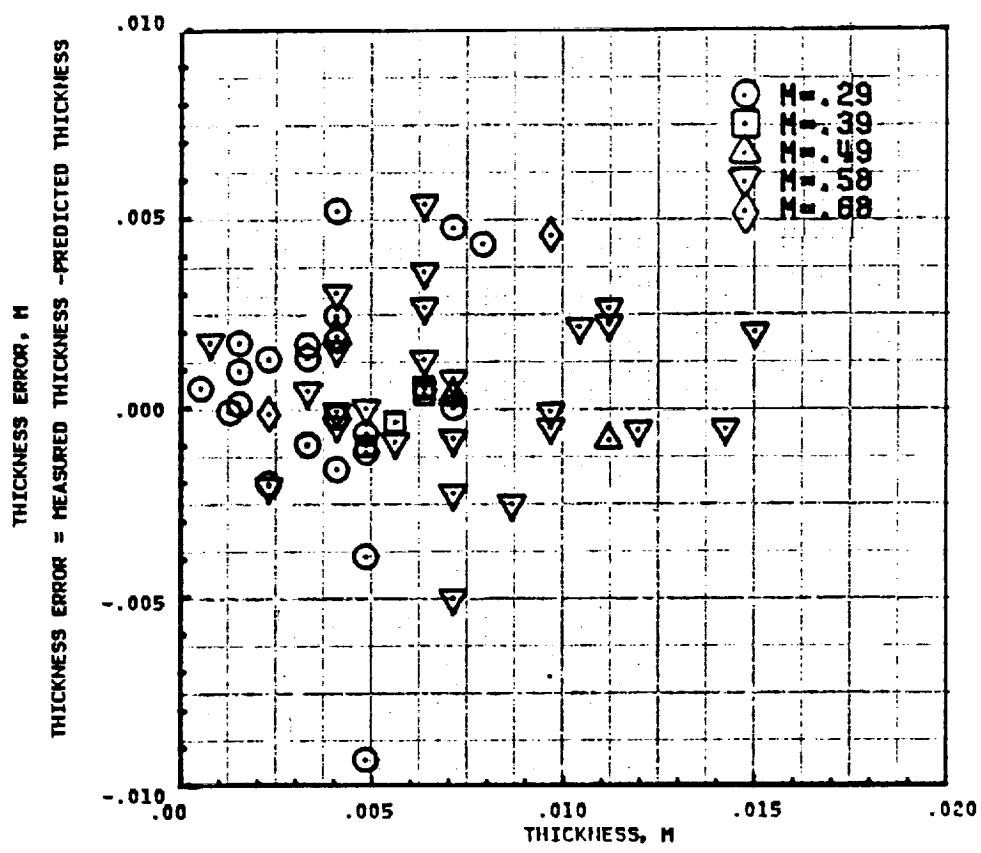
Figure 60. - Correlation of incremental pitching moment relationship with NRC data.

ORIGINAL PAGE IS
OF POOR QUALITY

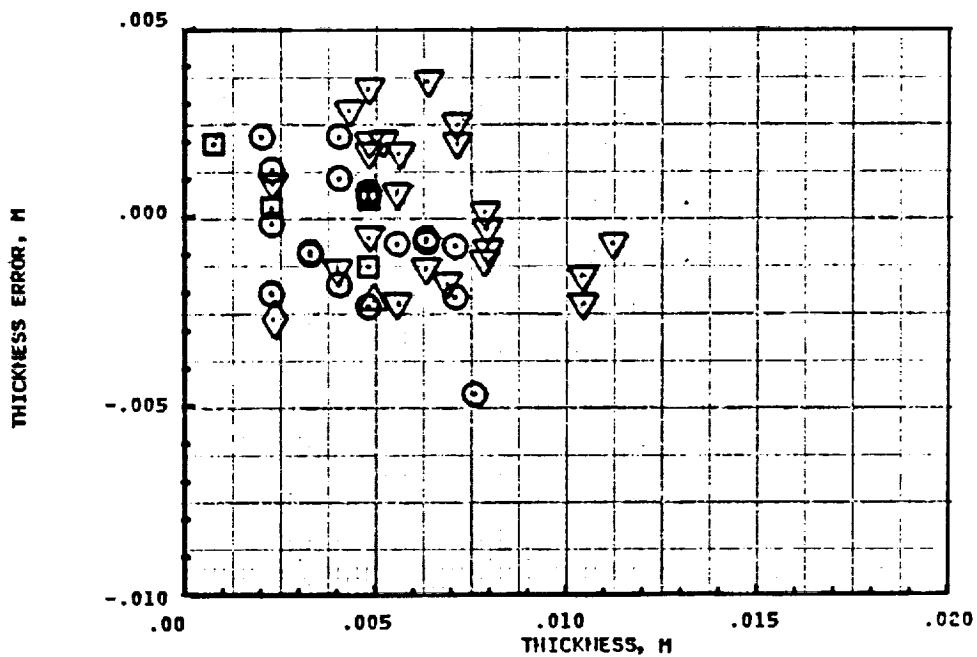


a. NACA 0012

Figure 61. - Correlation of ice thickness relationships with NRC data.



b. SC1095



c. SSC-A09

ORIGINAL PAGE IS
OF POOR QUALITY

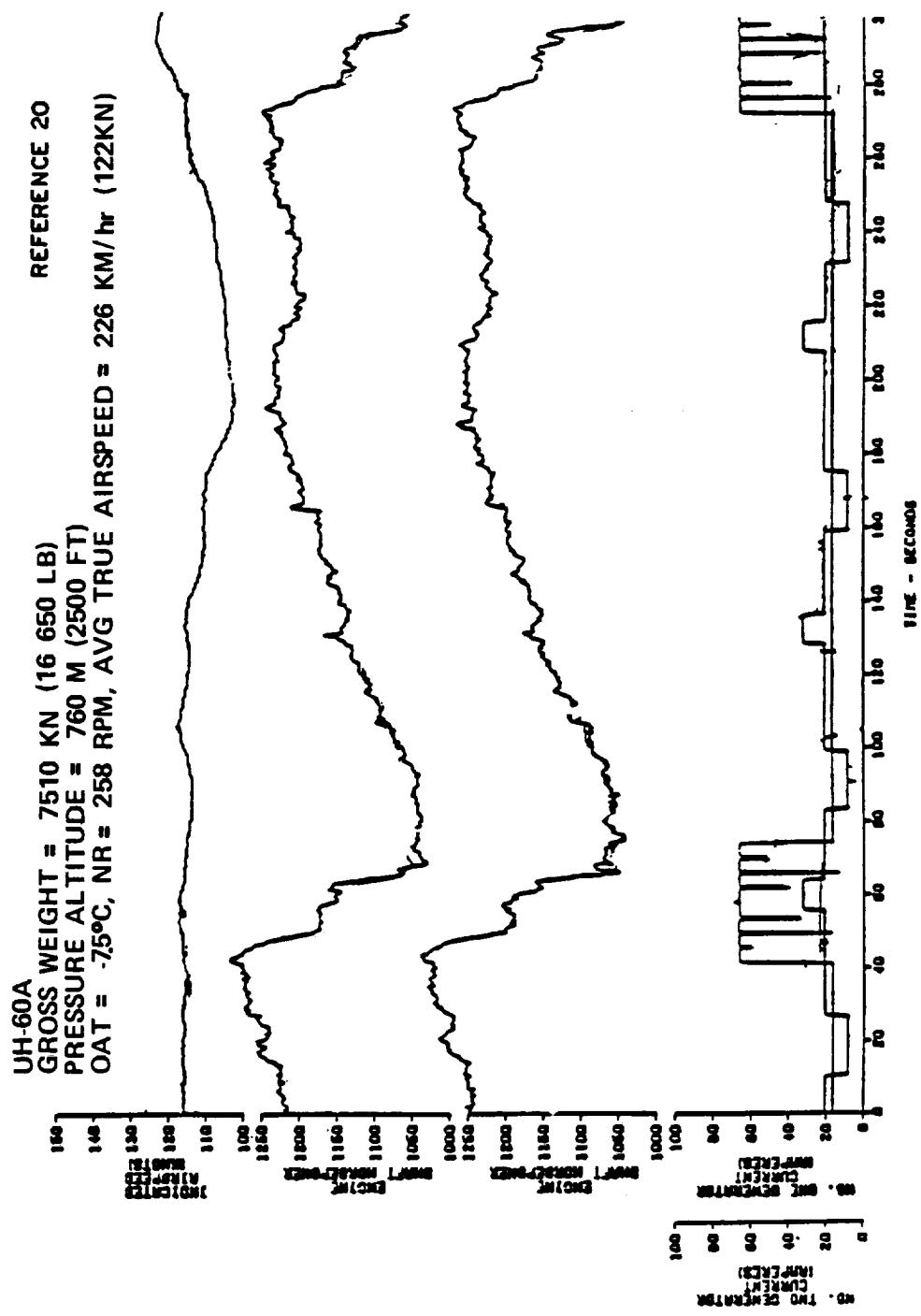


Figure 62. - Rotor torque rise trend versus icing time.

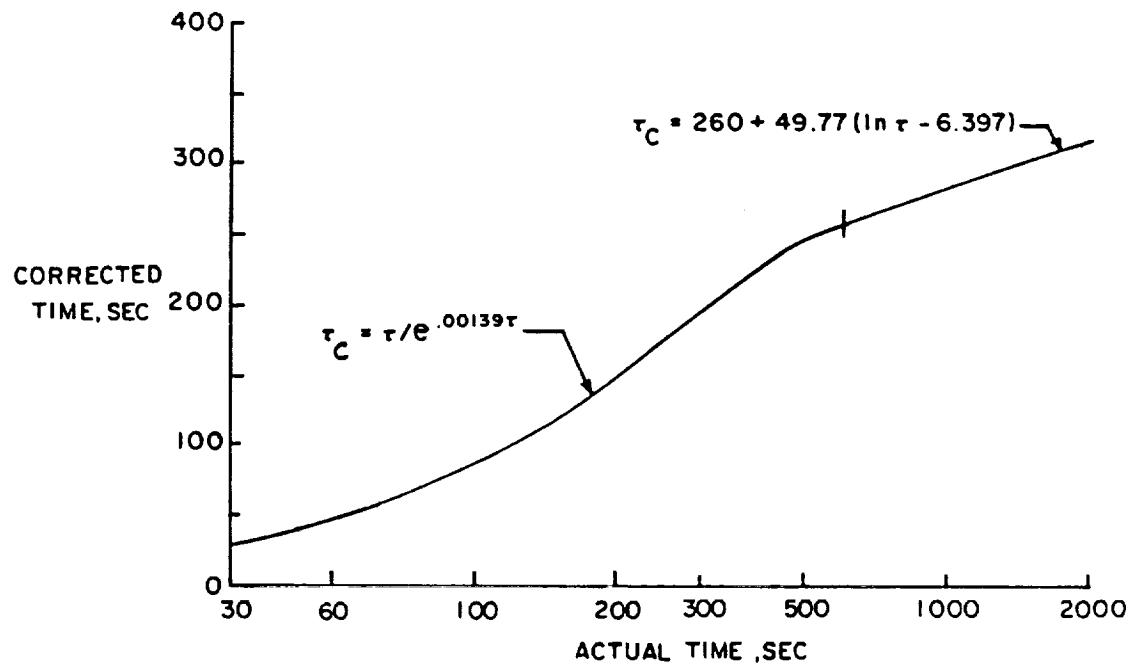


Figure 63. - Corrected icing time versus actual exposure time.

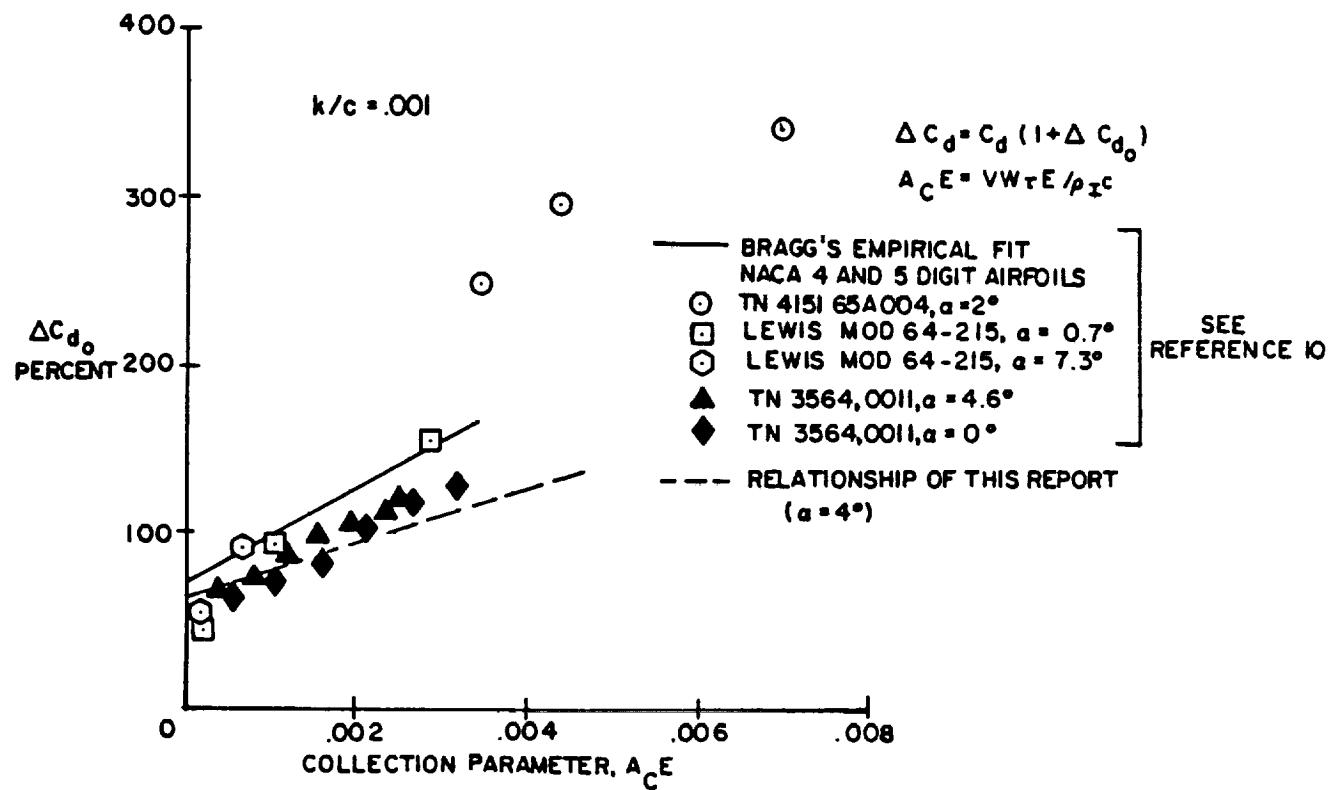


Figure 64. - Rime ice drag coefficient correlation.

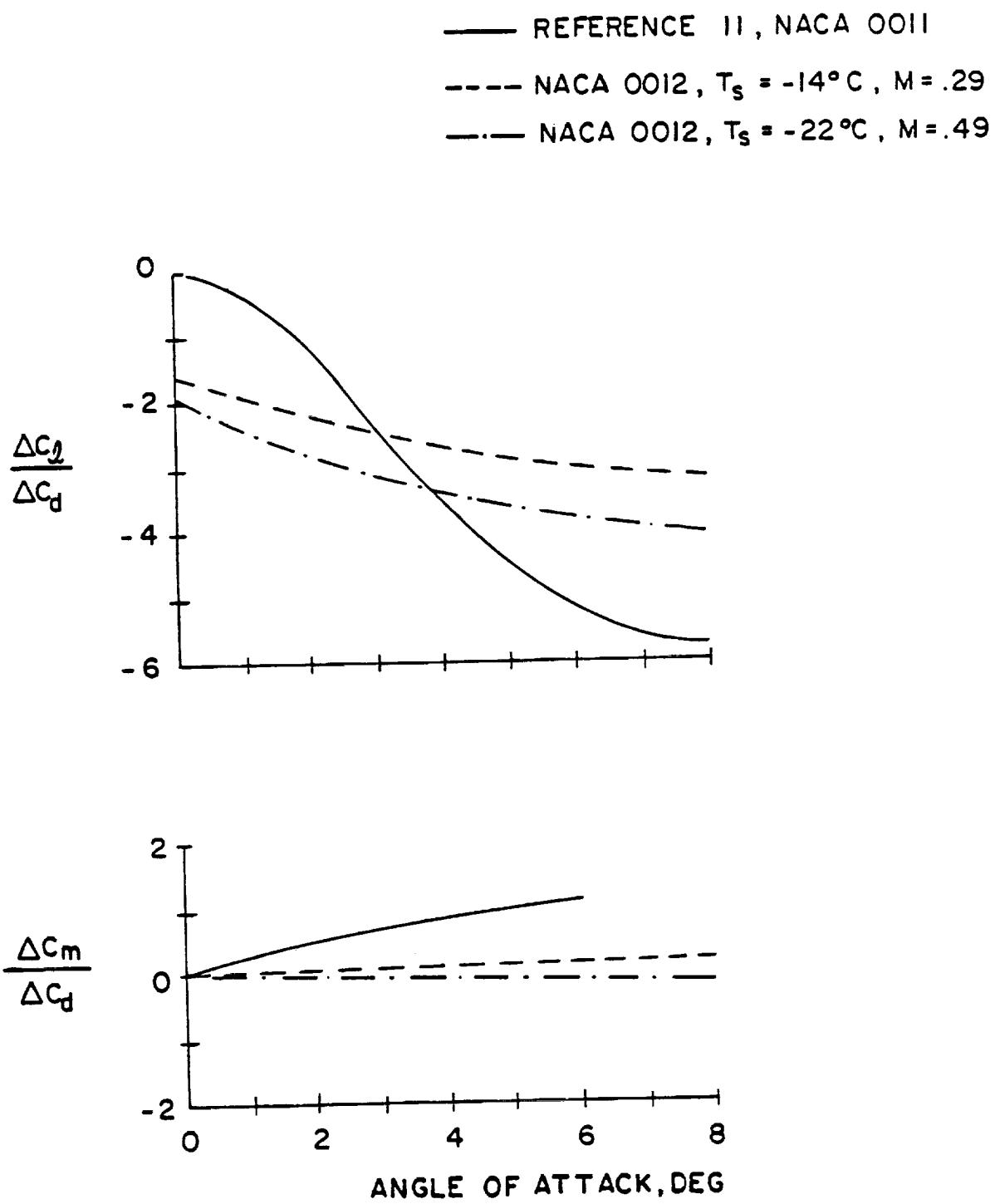
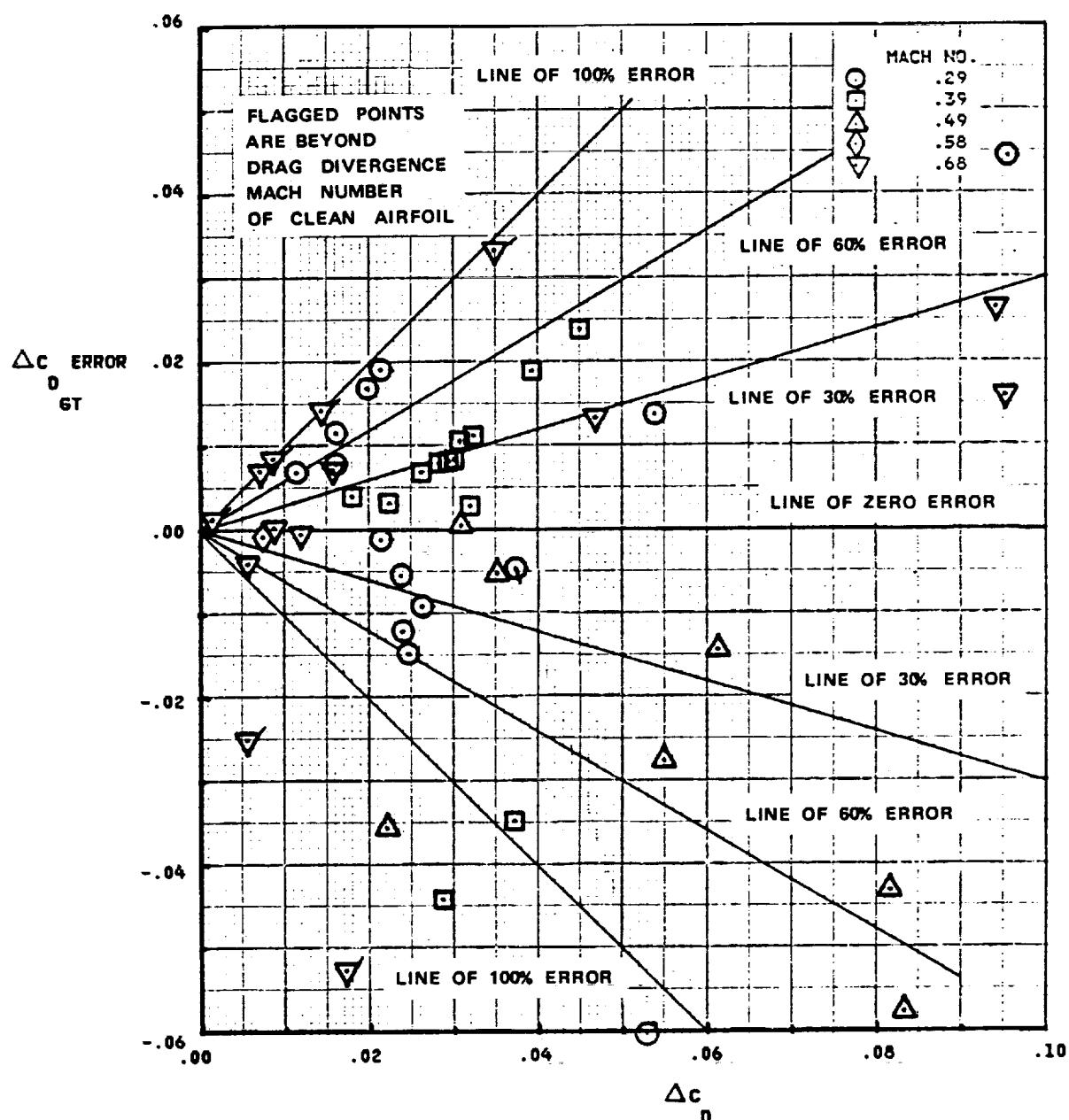
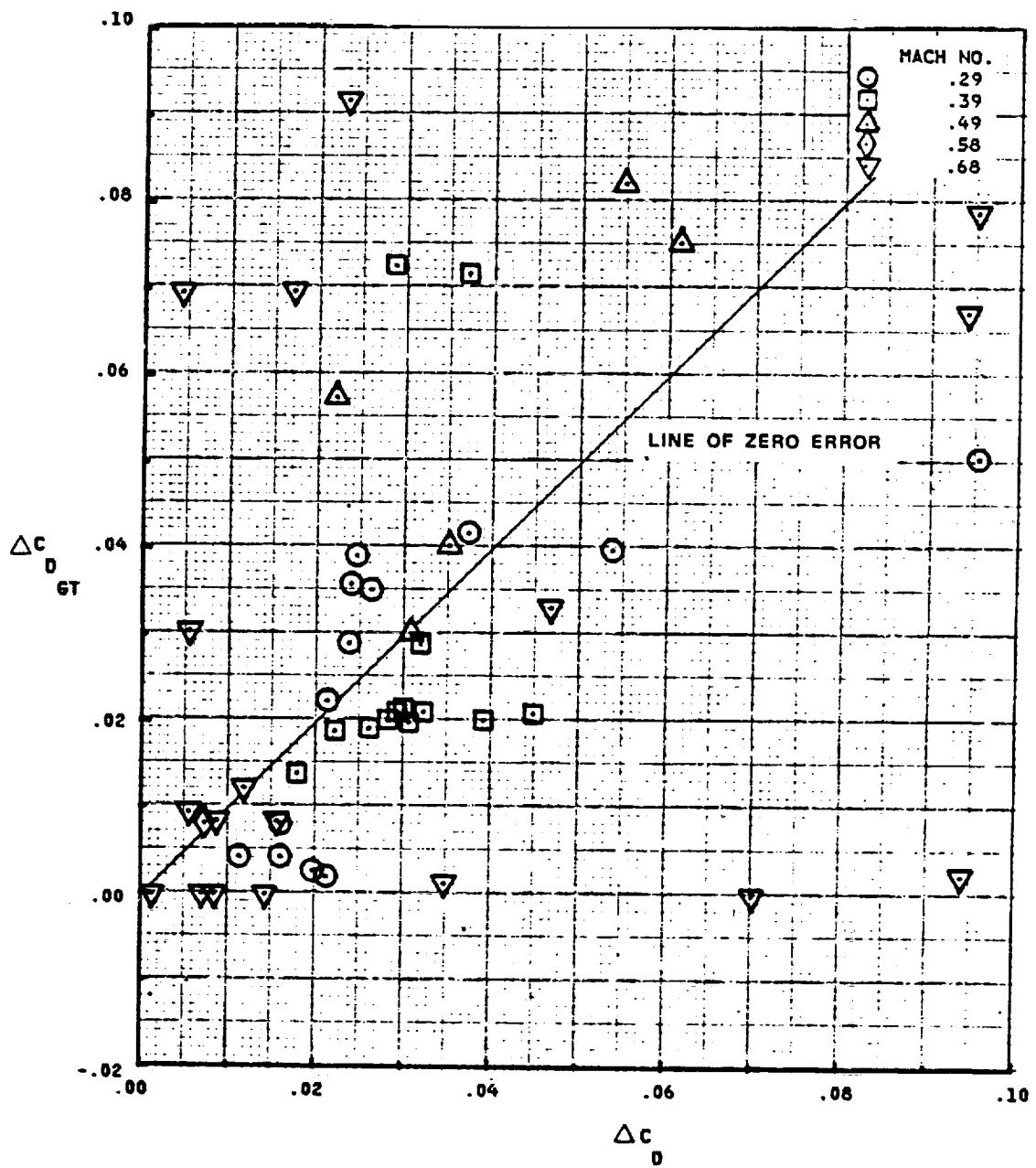


Figure 65. - Gray lift and pitching moment coefficient versus NRC data.



- a. Gray correlation error versus the measured drag coefficient increment for the NACA 0012 airfoil.

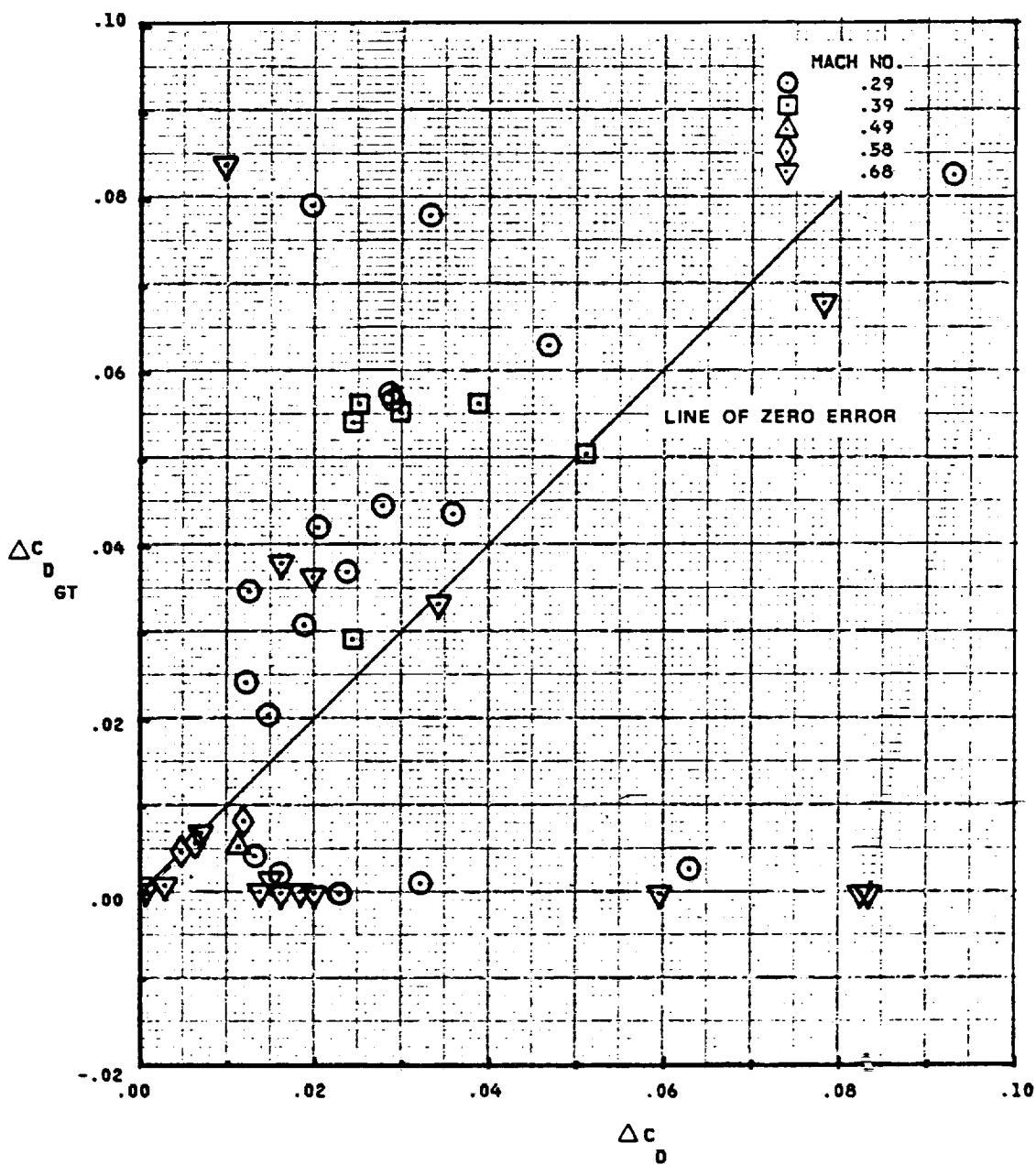
Figure 66. - Grey drag coefficient correlation versus NRC data.



b. Predicted drag increments versus NRC data for the NACA 0012 airfoil.

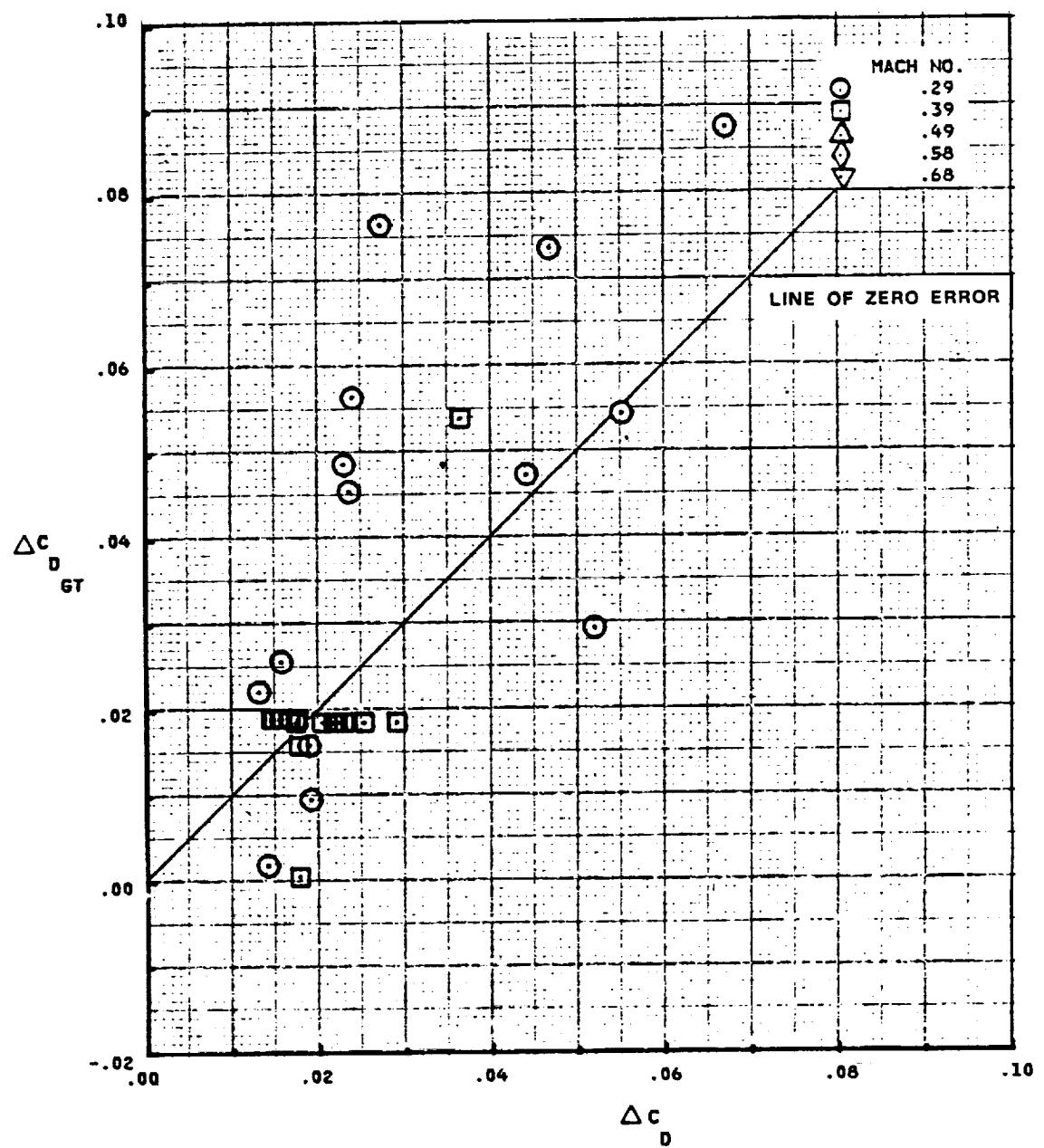
Figure 66. - (Continued)

ORIGINAL PAGE IS
OF POOR QUALITY.



- c. Predicted drag increments versus NRC data for the SC1095 airfoil.

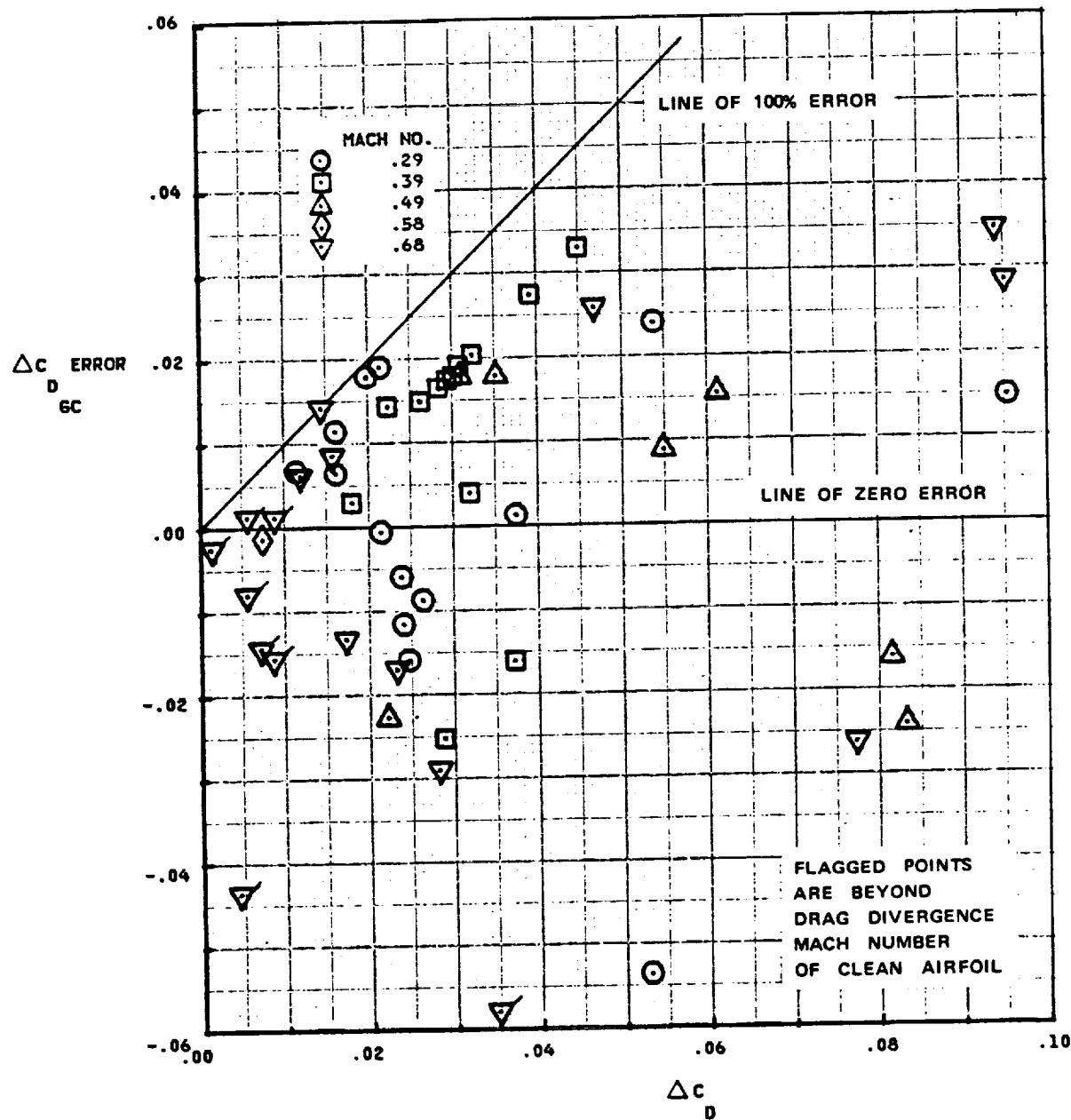
Figure 66. - (Continued)



d. Predicted drag increments versus NRC data for the SSC-A09 airfoil.

Figure 66. - (Continued)

ORIGINAL PAGE IS
OF POOR QUALITY



- e. Effect of the use of corrected temperature in Gray correlation for the NACA 0012 airfoil.

Figure 66. - (Concluded)

ORIGINAL PAGE IS
OF POOR QUALITY

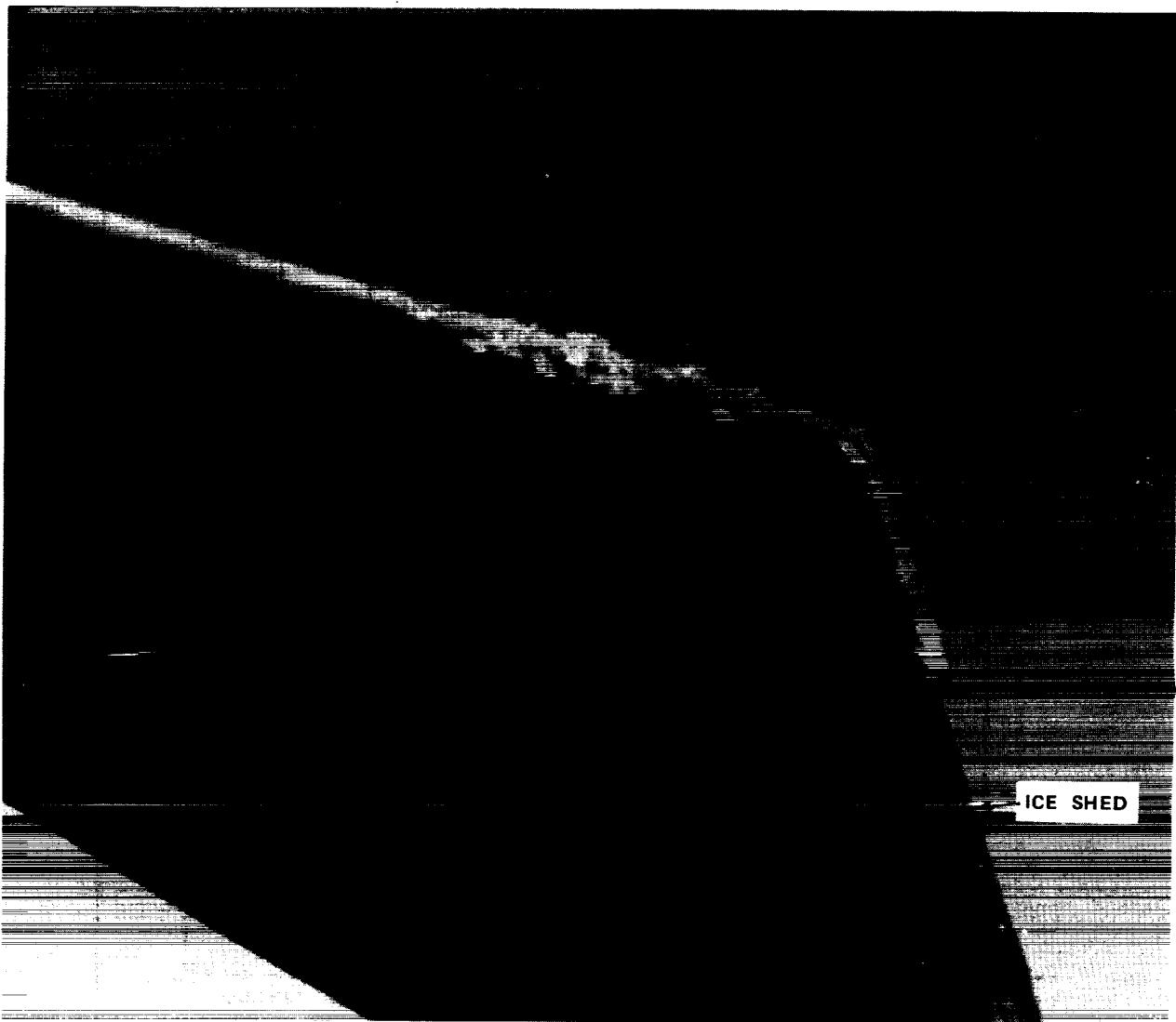
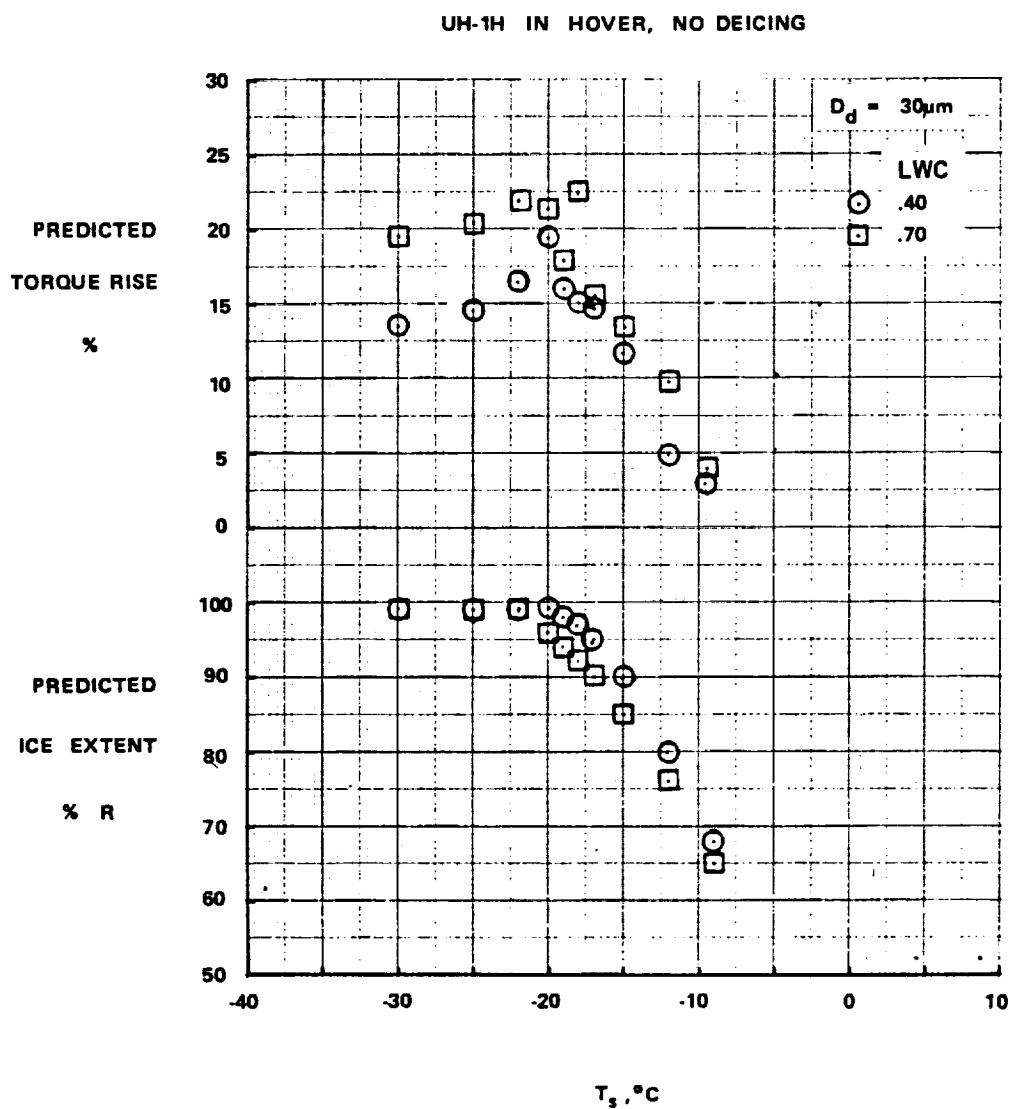


Figure 67. - Icing on a swept rotor tip.



- a. Predicted torque rise and ice extent versus static temperature.

Figure 68. - Rotorcraft torque rise.

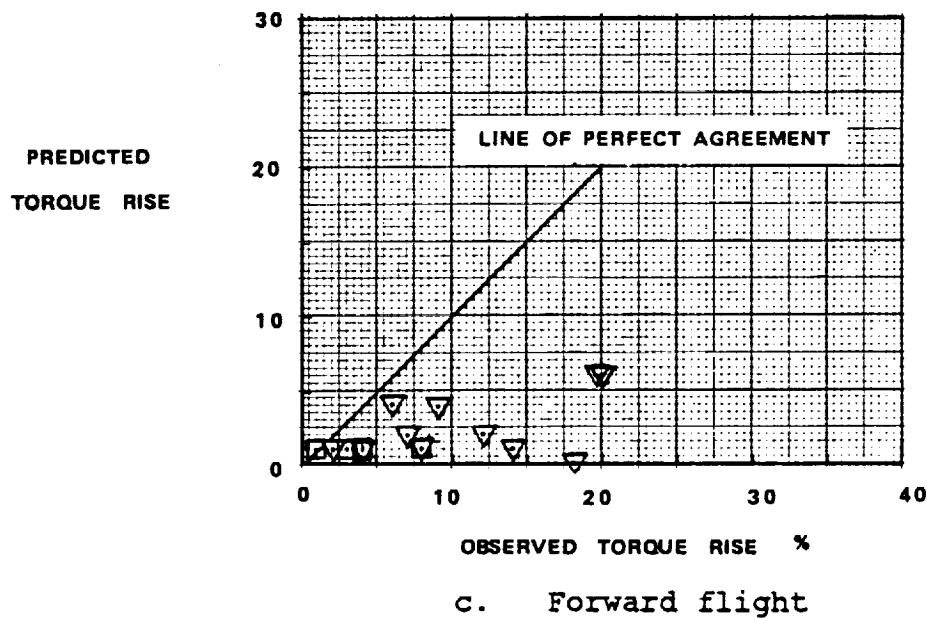
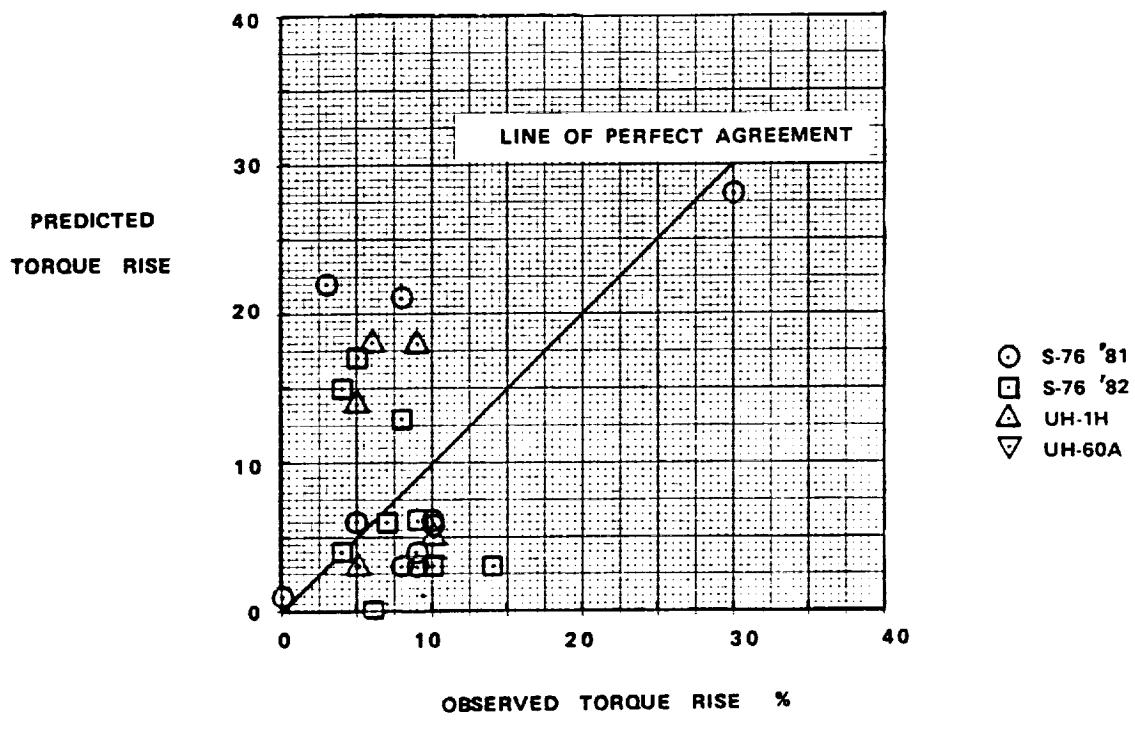


Figure 68. - (Concluded)

ORIGINAL PAGES
OF POOR QUALITY

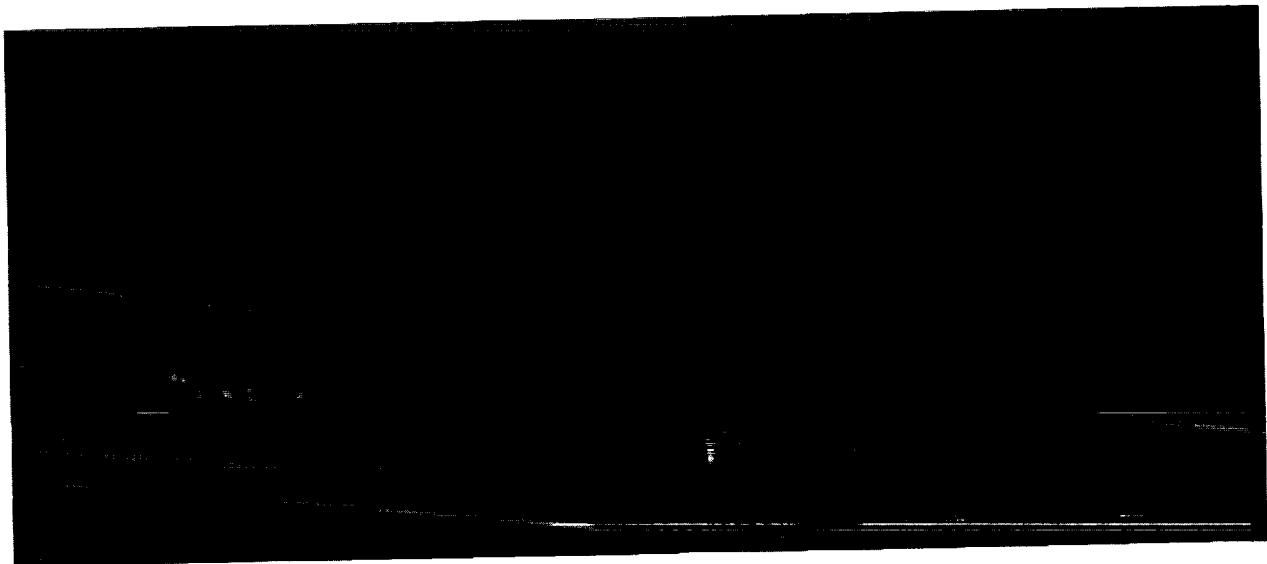
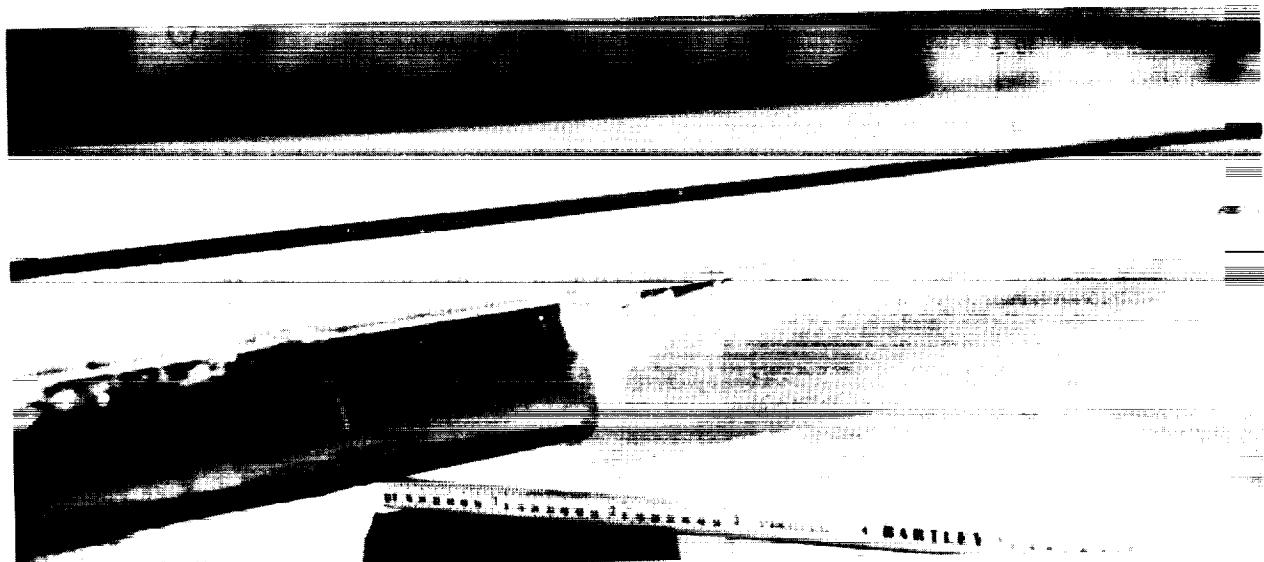
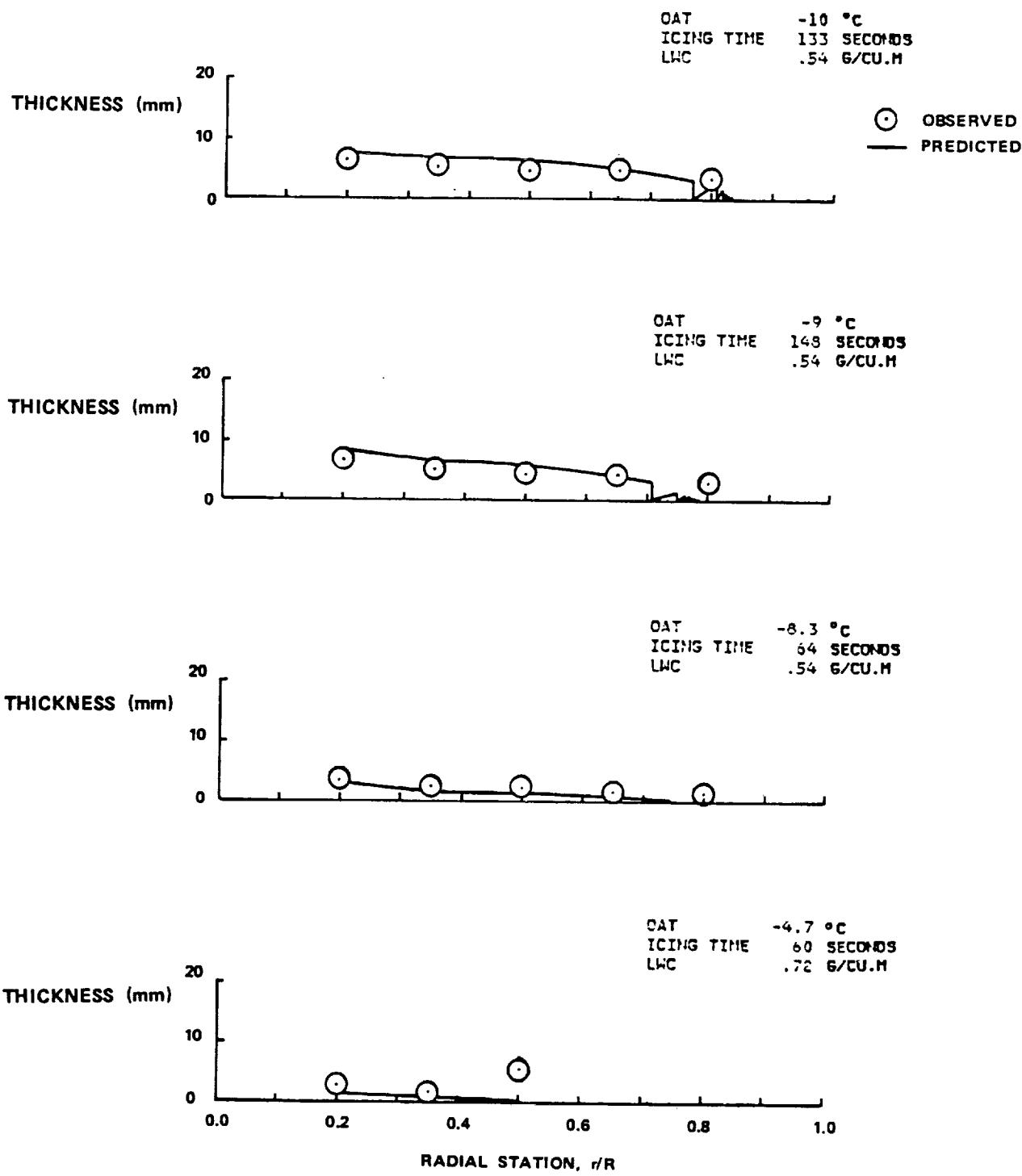
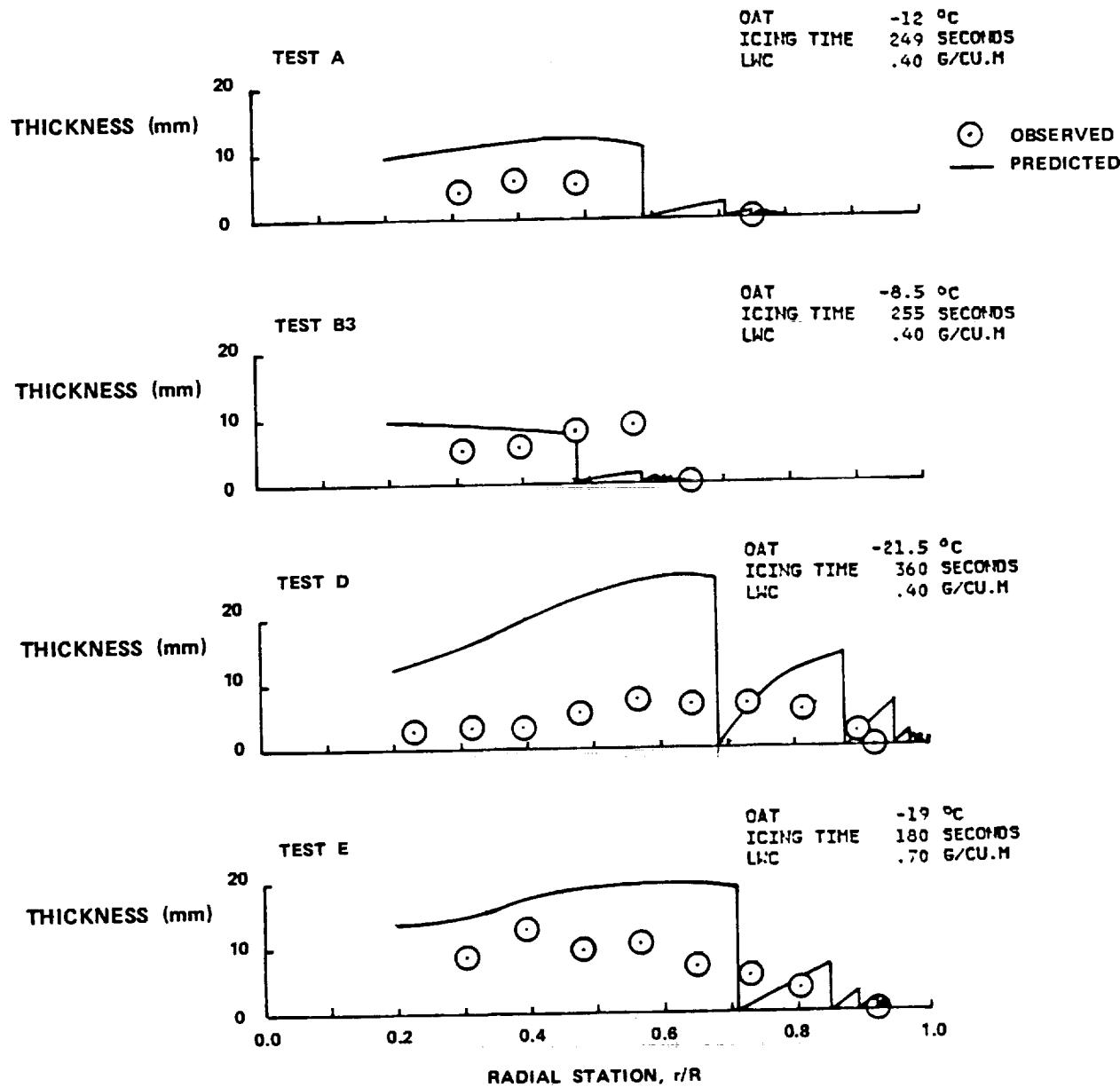


Figure 69. - Rotorcraft ice shape photographs.



a. S-76A

Figure 70. - Rotorcraft ice thickness correlation.



b. JUH-1H

Figure 70. - (Concluded)

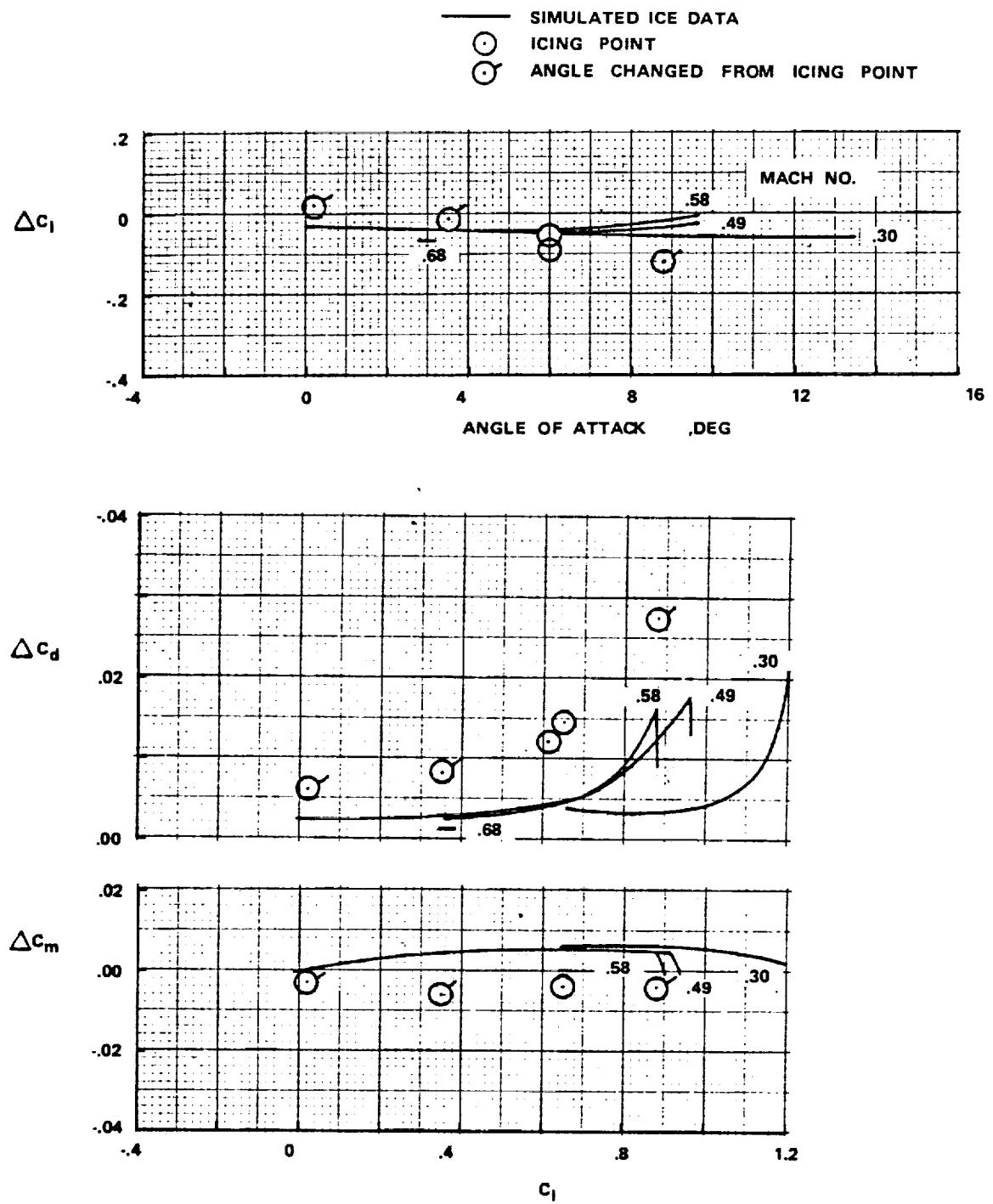


Figure 71. - Force and moment increments for simulated ice -
NACA 0012 Ice No. 1.

ORIGINAL PAGE IS
OF POOR QUALITY

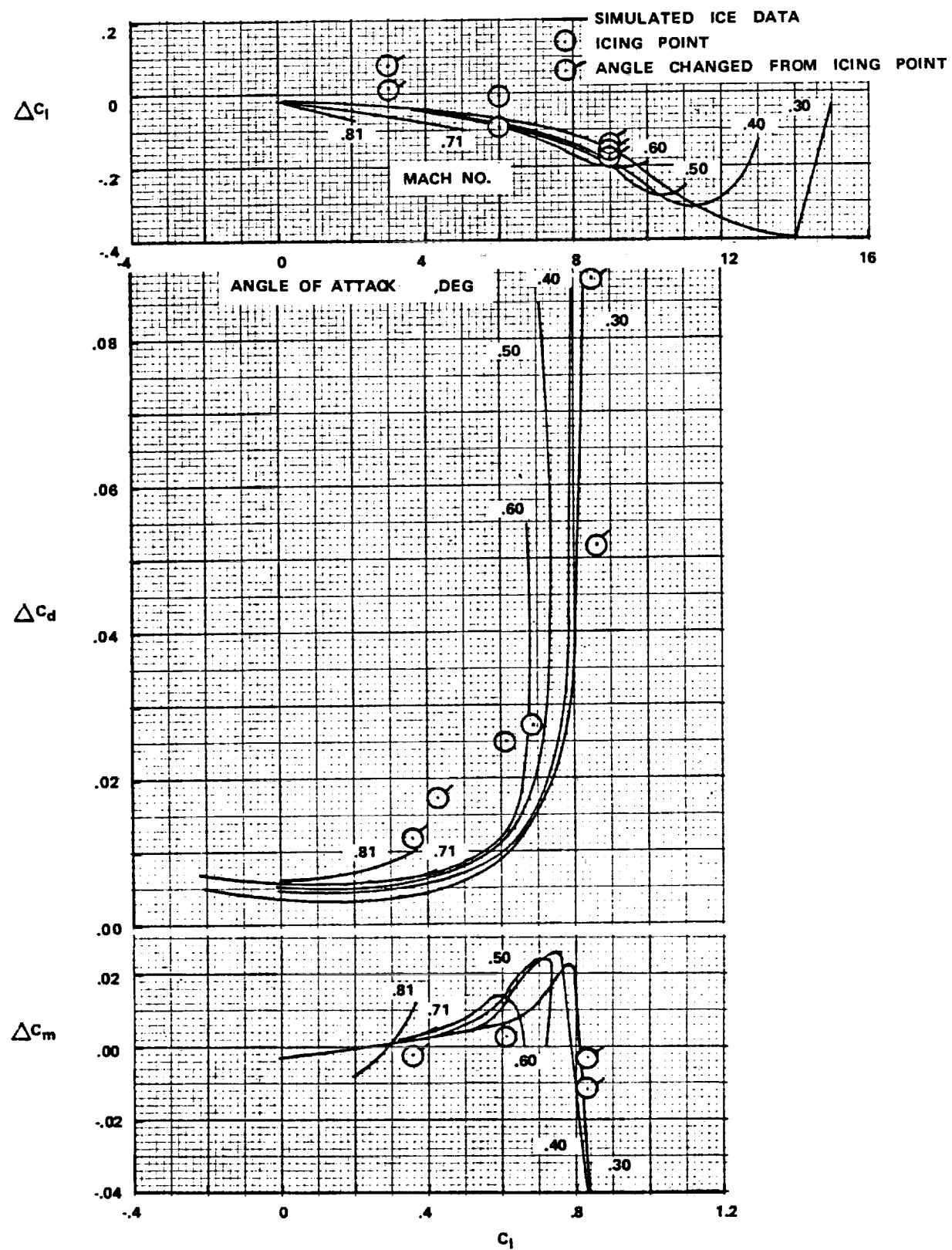


Figure 72. - Force and moment increments for simulated ice -
NACA 0012 Ice No. 2.

ORIGINAL PAGE IS
OF POOR QUALITY

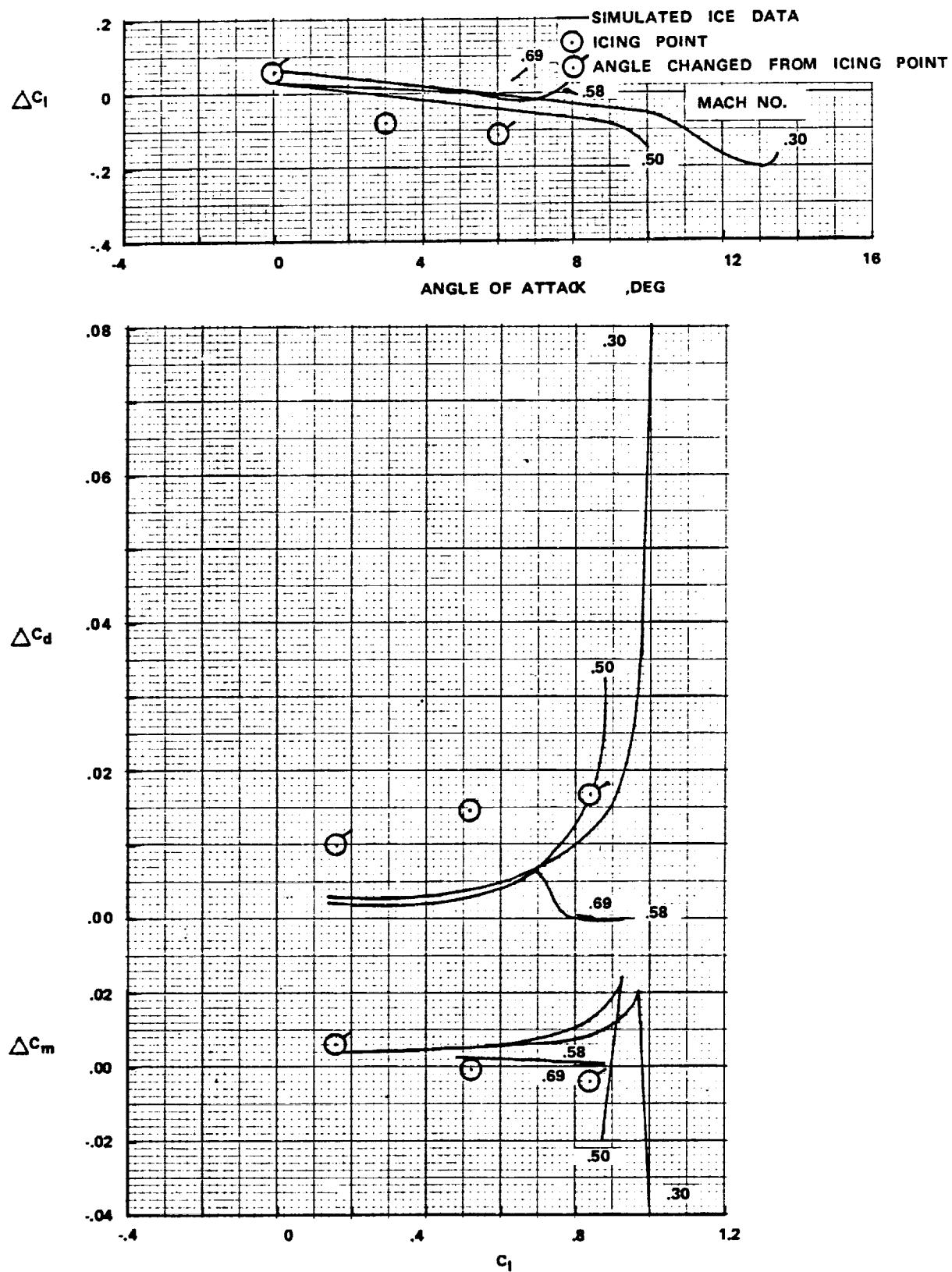


Figure 73. - Force and moment increments for simulated ice -
SC1095 Ice No. 2.
132

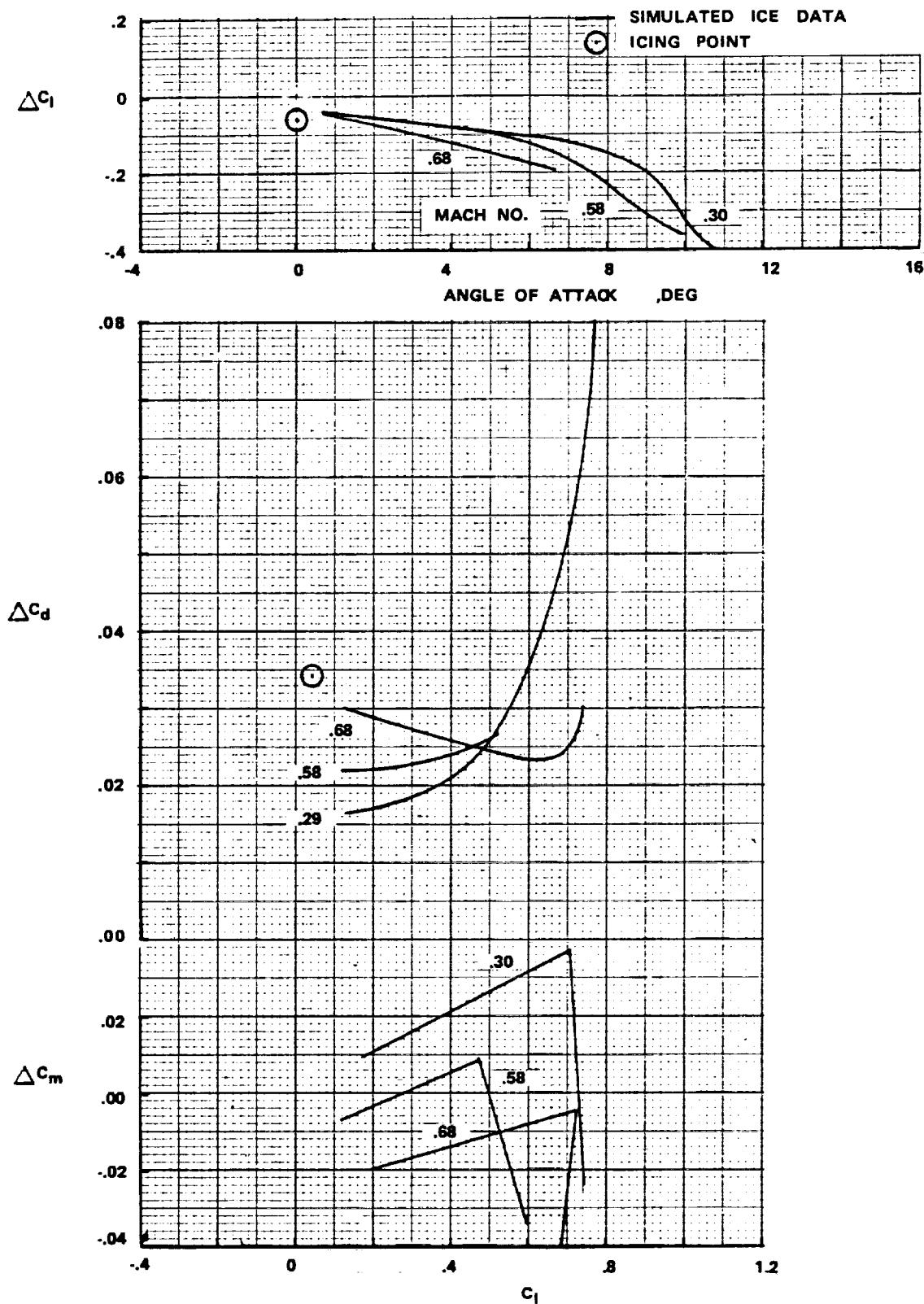


Figure 74. - Force and moment increments for simulated ice -
SSC-A09 Ice No. 2.

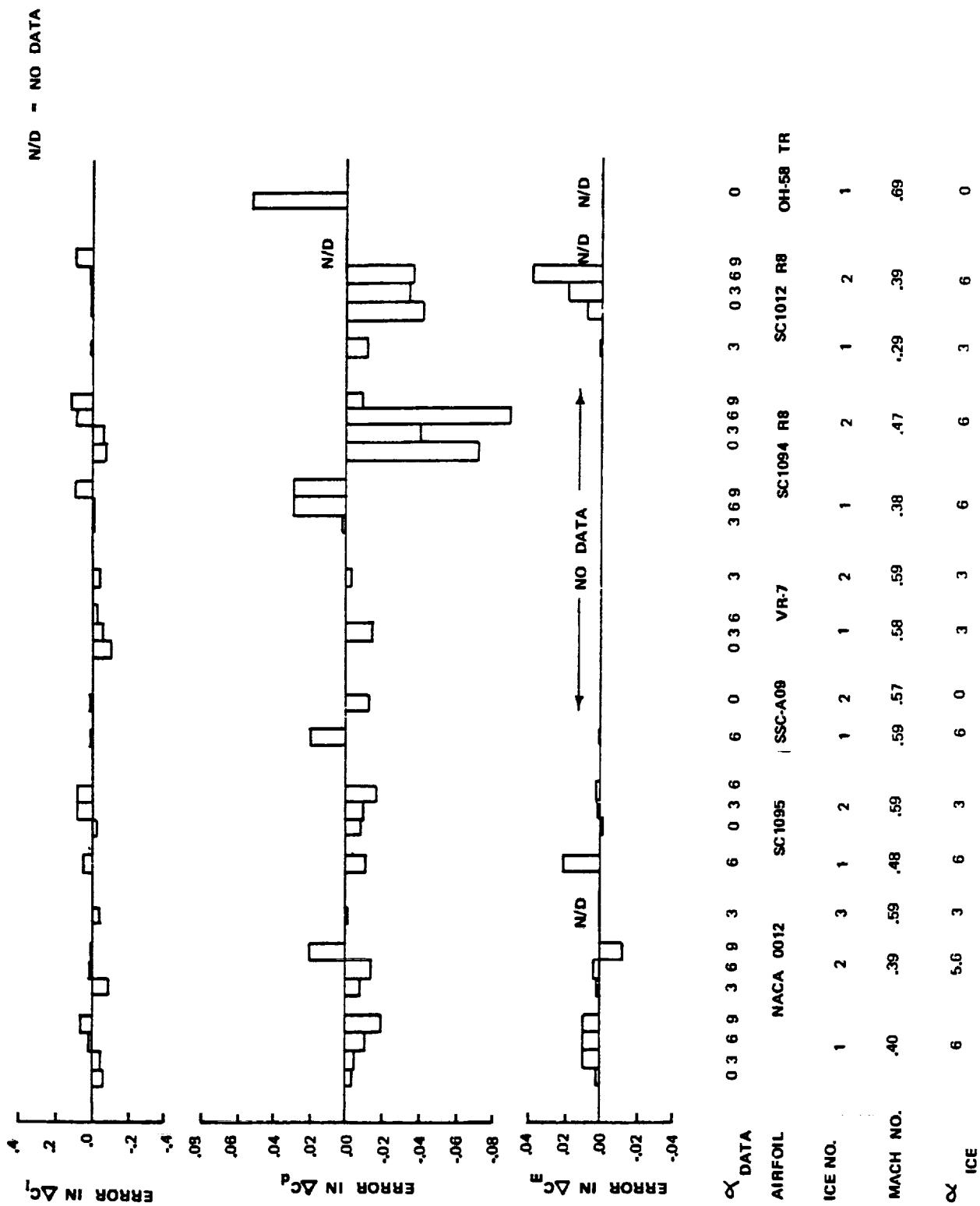


Figure 75. - Summary of simulated ice force and moment increments.

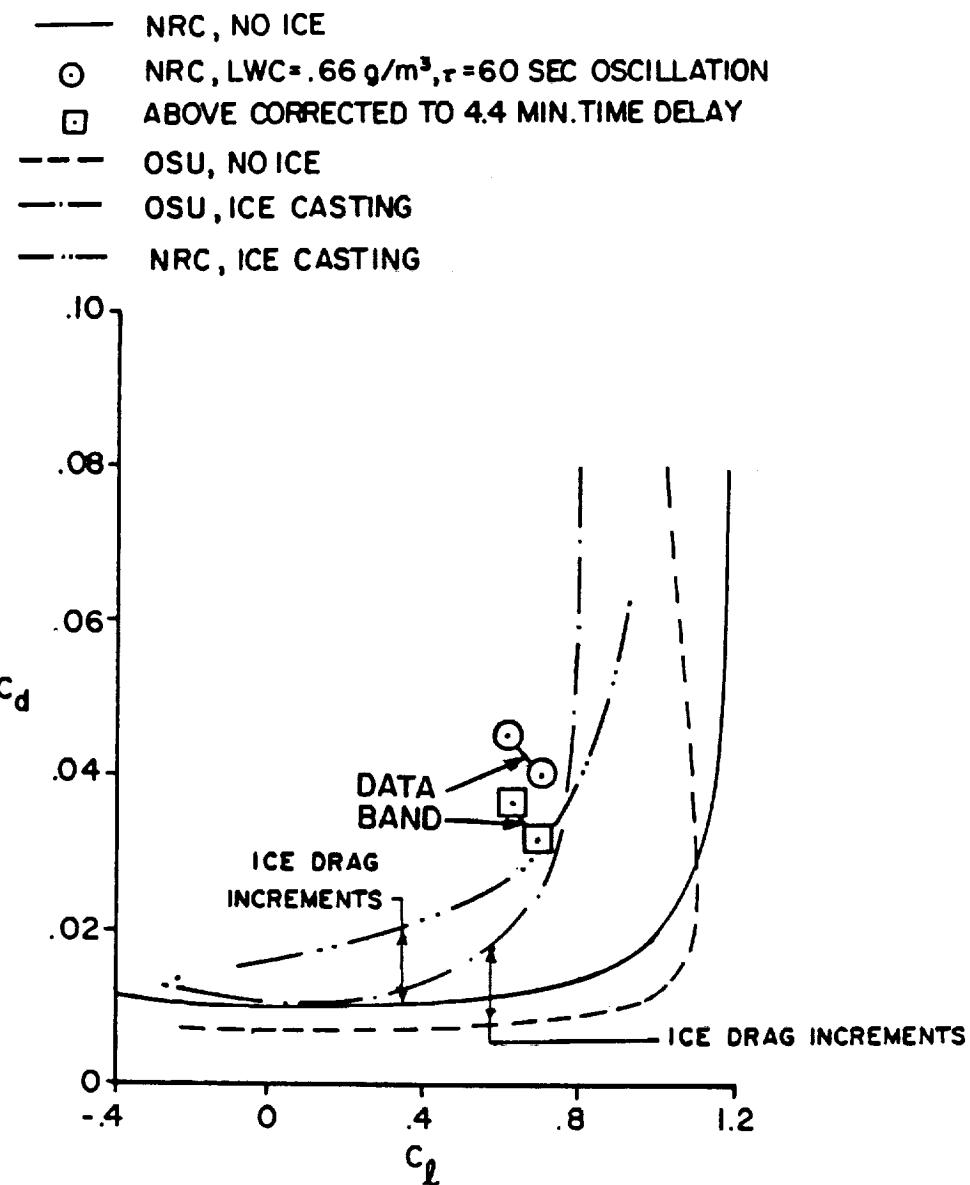


Figure 76. - Observed drag differences.

NACA 0012 IN OSU 6 × 22 TUNNEL

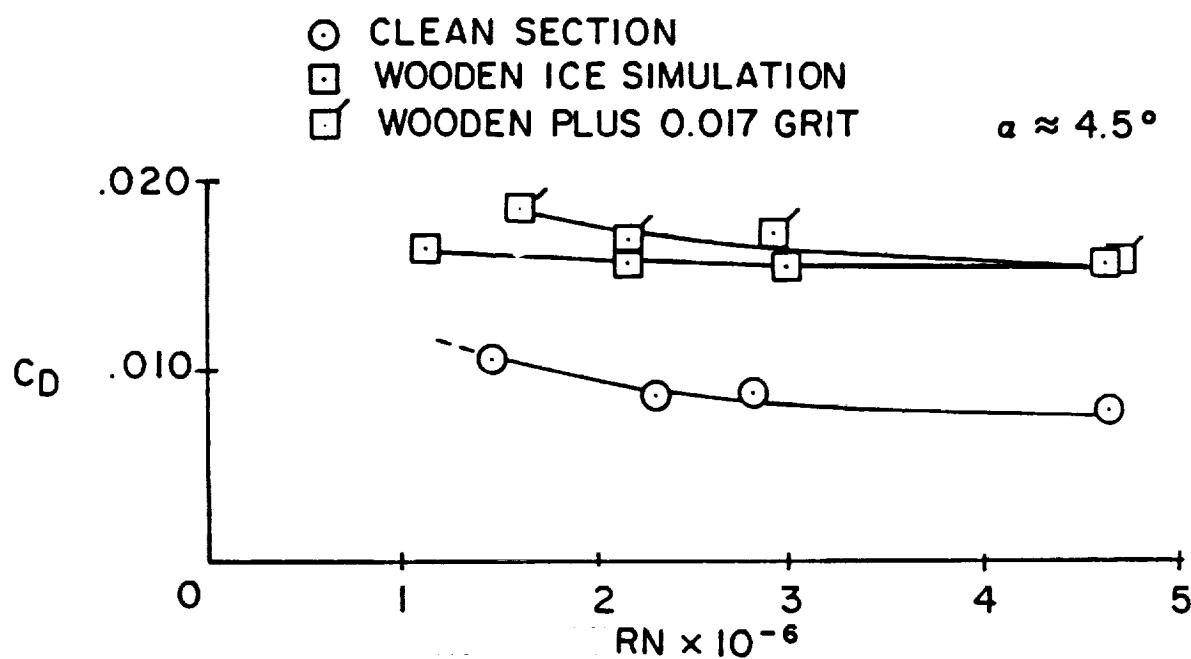


Figure 77. - Effect of Reynolds number on drag.

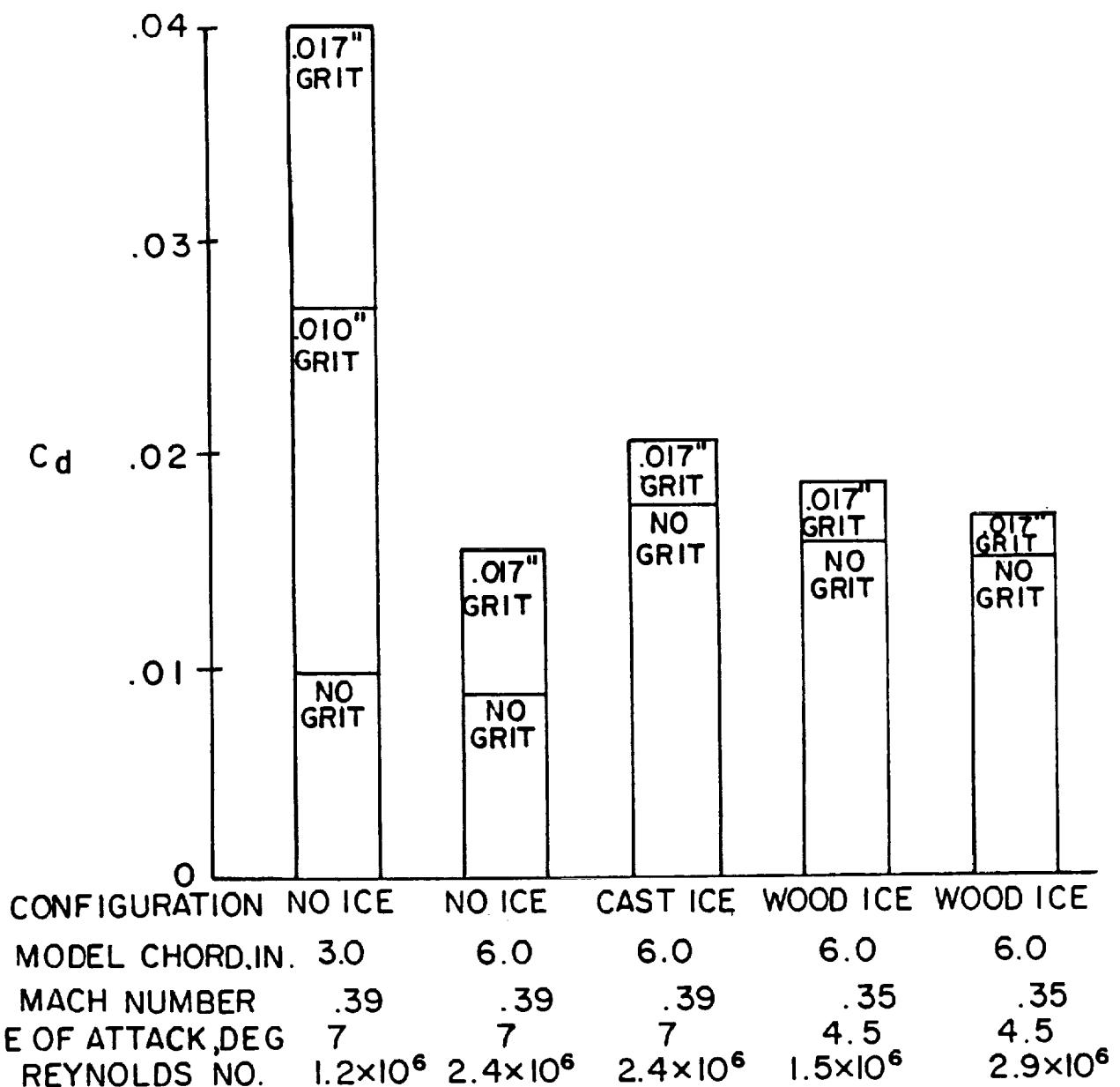


Figure 78. - Effect of roughness on drag.

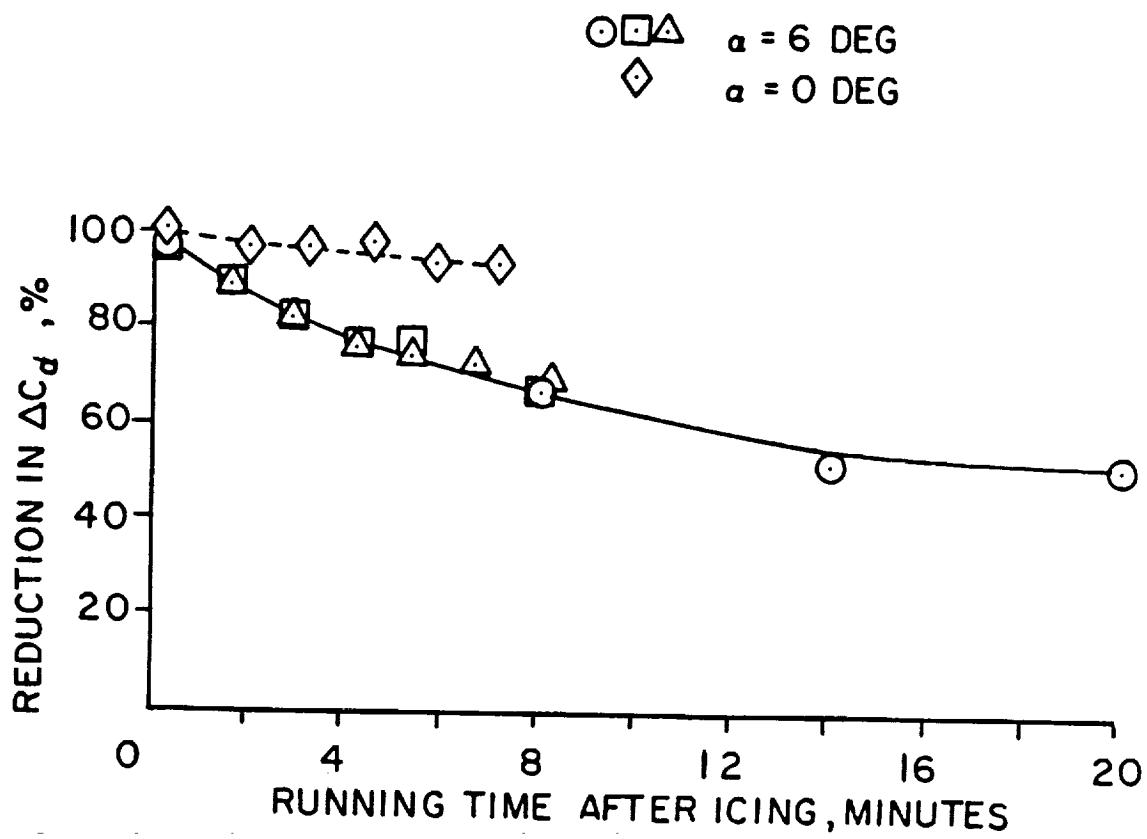


Figure 79. - Effect of self-shedding and sublimation on drag - spray off.

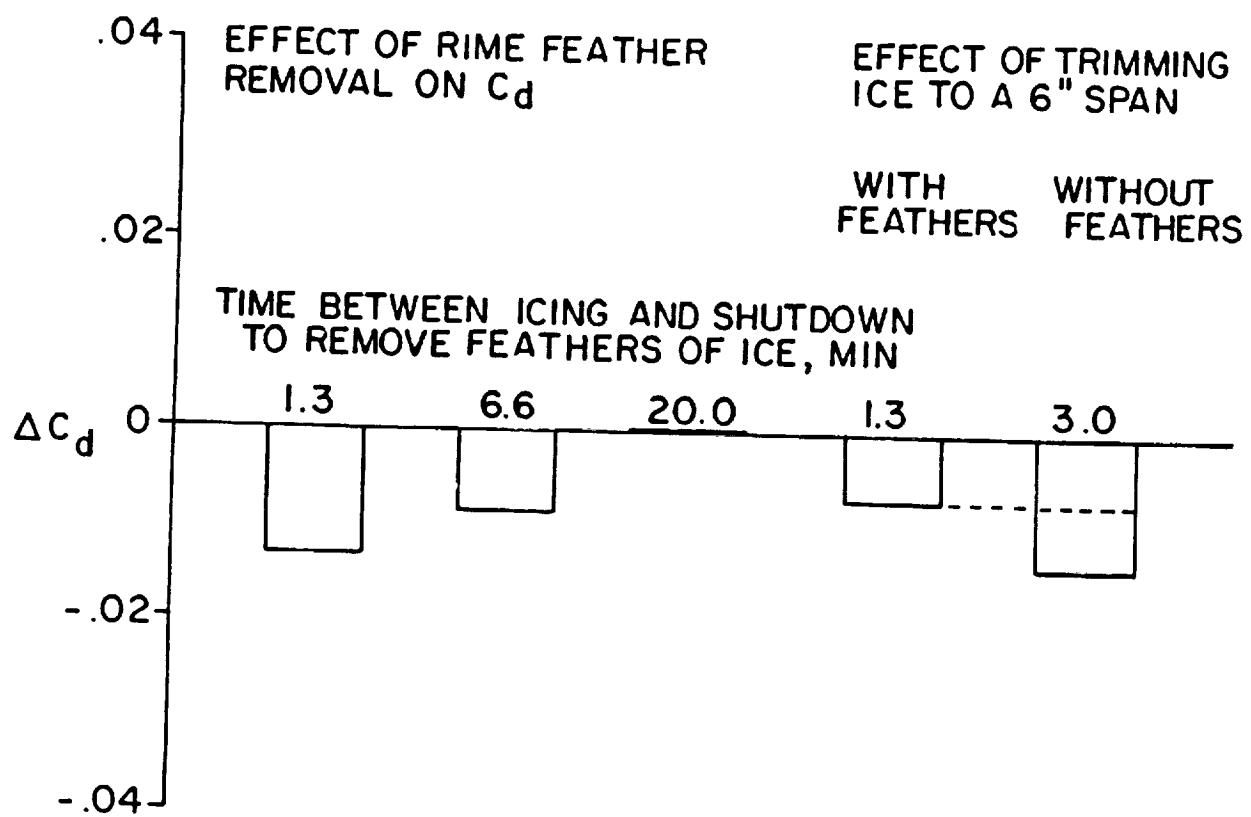


Figure 80. - Effect of feathers and part span ice on drag.

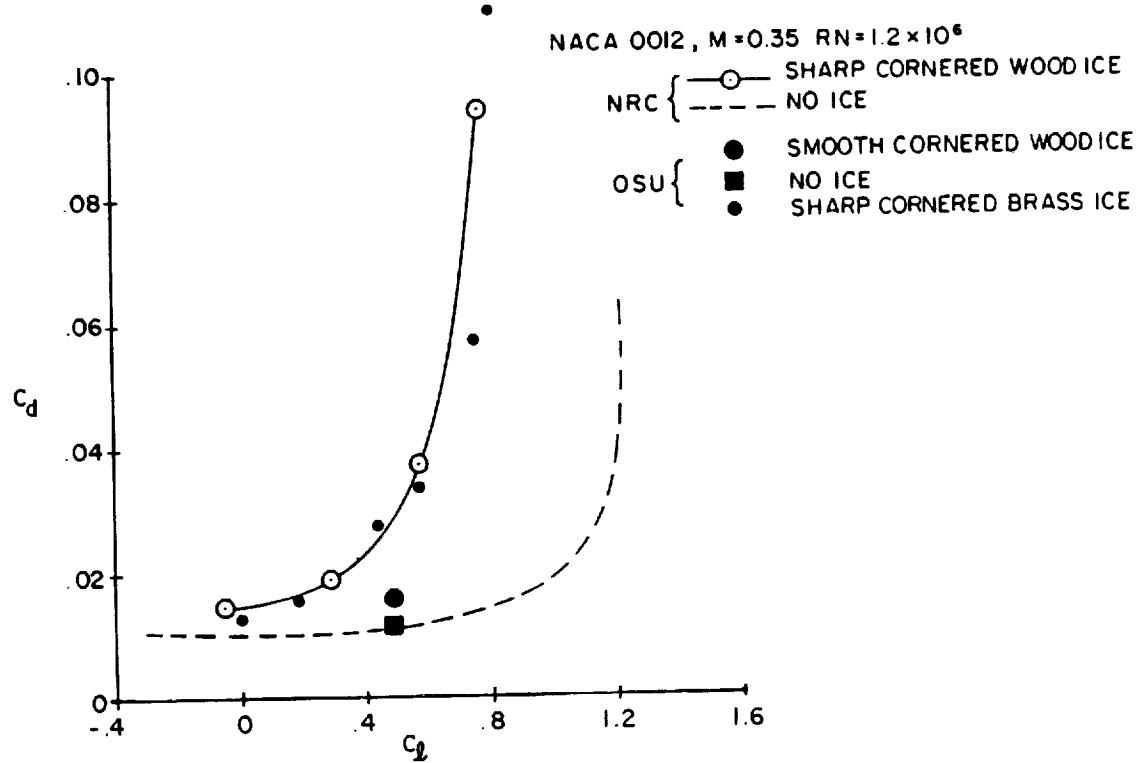


Figure 81. - Simulated ice drag as tested in the NRC and OSU wind tunnels.

APPENDIX A
Run Log and Tabulated Test Data
NRC Phase I Test

Description of Run Log/Data Headings

MACH	Free stream Mach number
RN	Model Reynolds number
ALPH	Model angle of attack, degrees
CLP	Lift coefficient calculated from integrated airfoil surface pressures
CLPL	Lift coefficient calculated from ceiling and floor static pressures
CL40	Lift coefficient calculated from airfoil static pressures at X/C of 40%
CDW	Drag coefficient calculated from wake momentum depression integration
CMP	Quarter chord pitching moment coefficient calculated from integrated airfoil surface pressures
L/D	Lift-drag ratio, CLP/CDW when CLP is available, otherwise CLPL/CDW
TOT T	Free stream total temperature, °C
STA T	Free stream static temperature, °C
LWC	Liquid water content, g/m ³
TIME	Icing time, seconds
DIA	Mean volume droplet diameter, microns
FREQ	Airfoil oscillation frequency, Hz
AMP	Airfoil oscillation amplitude (peak-to-peak), degrees
LENGTH	Length of upper surface ice growth from airfoil surface to tip of rime growth or to tip of upper horn
WIDTH	Distance between tips of upper and lower horns

APPENDIX A (CONT)

CONFIGURATION - 2, SC1095 AIRFOIL

RUN LOG AND TABULATED TEST DATA											REMARKS				
RUN	HACH	RN	ALPH	CLP	CPL	CL40	CDW	CMP	L/D	TOT T	STA T	LMC TIME	DIA FREQ	AMP LENGTH	MIDTH
1	TO	27	0.29	1.0	0.0	0.12	0.10	0.10	0.0093	-0.014	12.5	20.0	15.1		
28	0.29	1.0	-2.00	-0.13	-0.10	-0.12	0.0100	-0.012	-12.7	20.0	15.1				
29	0.29	1.0	0.0	0.12	0.11	0.12	0.0103	-0.015	11.7	20.0	15.1				
30	0.29	1.0	3.00	0.44	0.37	0.42	0.0109	-0.016	40.6	20.0	15.1				
31	0.29	1.0	6.00	0.72	0.61	0.69	0.0132	-0.020	54.4	20.0	15.1				
32	0.29	1.0	9.00	1.06	1.07	1.02	0.0198	-0.020	53.4	20.0	15.3				
33	0.29	0.9	12.00	1.30	1.23	1.21	0.0350	-0.018	37.1	20.0	15.5				
34	0.28	0.9	13.00	1.16	1.19	1.34	0.1664	-0.138	7.2	20.0	15.1				
35	0.29	1.0	14.00	1.22	1.19	1.46	0.1928	-0.151	6.5	20.0	15.1				
36	0.29	1.0	15.00	1.22	1.18	1.42	0.2180	-0.160	5.7	20.0	15.1				
37	0.29	1.0	0.0	0.11	0.11	0.09	0.0095	-0.016	11.2	20.0	15.1				
38	0.29	0.9	0.0	0.09	0.07	0.08	0.0097	-0.015	8.9	27.0	22.1				
39	0.29	0.9	9.13	1.10	1.08	1.08	0.0192	-0.021	57.4	27.0	22.1				
40	0.29	0.9	11.00	1.26	1.23	1.16	0.0270	-0.017	46.8	27.0	22.1				
41	0.29	0.9	12.00	1.31	1.32	1.25	0.0816	-0.025	16.1	27.0	22.0				
42	0.29	0.9	12.50	1.19	1.15	1.40	0.1533	-0.129	7.8	27.0	22.0				
43	0.30	0.9	13.00	1.19	1.14	1.38	0.1638	-0.144	6.7	27.0	22.0				
44	0.30	0.9	0.25	0.11	0.05	0.12	0.0092	-0.016	11.5	27.0	22.1				
45	0.29	0.9	-0.10	0.05	0.02	0.04	0.0110	-0.013	4.1	26.1	17.5				
46	0.39	1.2	-2.00	-0.17	-0.16	-0.16	0.0109	-0.013	-15.7	26.1	17.5				
47	0.39	1.2	0.0	0.08	0.04	0.08	0.0115	-0.014	6.6	26.1	17.5				
48	0.39	1.2	3.00	0.44	0.40	0.44	0.0108	-0.016	41.2	26.1	17.3				
49	0.39	1.2	6.00	0.80	0.76	0.79	0.0141	-0.020	56.7	26.1	17.3				
50	0.39	1.2	9.00	1.17	1.15	1.12	0.0212	-0.022	55.1	26.1	17.4				
51	0.39	1.2	11.00	1.37	1.34	1.28	0.0306	-0.015	44.8	26.1	17.3				
52	0.39	1.2	12.00	1.19	1.15	1.42	0.1568	-0.137	7.7	26.1	17.2				
53	0.39	1.2	13.00	1.19	1.16	1.40	0.1587	-0.153	7.6	26.1	17.1				
54	0.39	1.2	0.0	0.06	0.04	0.05	0.0110	-0.015	5.4	26.1	17.2				
55	0.39	1.2	0.0	0.06	0.04	0.05	0.0116	-0.015	5.2	26.1	12.8				
56	0.48	1.5	-2.00	-0.21	-0.21	-0.21	0.0122	-0.010	-17.3	26.1	12.6				
57	0.48	1.5	0.0	0.05	0.04	0.04	0.0119	-0.012	4.4	26.1	12.4				
58	0.49	1.5	3.00	0.46	0.44	0.46	0.0114	-0.019	40.5	26.1	12.5				
59	0.49	1.5	6.00	0.85	0.83	0.83	0.0156	-0.022	54.4	26.1	12.7				
60	0.49	1.5	9.00	1.14	1.14	1.10	0.0535	-0.024	21.4	26.1	12.6				
61	0.49	1.5	11.00	1.24	1.17	1.34	0.1140	-0.106	10.9	26.1	12.5				
62	0.49	1.5	12.00	1.31	1.19	1.38	0.1253	-0.113	10.5	26.1	12.5				
63	0.49	1.5	0.0	0.08	0.07	0.07	0.0115	-0.015	7.1	26.1	12.7				
64	0.48	1.5	0.0	0.08	0.05	0.08	0.0125	-0.016	6.3	35.0	15.5				
65	0.58	1.6	0.0	0.06	0.05	0.06	0.0126	-0.015	5.2	63.9	61.5				
66	0.59	1.6	-2.00	-0.23	-0.24	-0.21	0.0127	-0.012	-17.9	42.2	21.7				
67												NO DATA			
68	0.58	1.5	0.0	0.06	0.04	0.06	0.0123	-0.015	4.8	56.1	35.2				
69	0.56	1.5	3.00	0.52	0.50	0.51	0.0130	-0.021	40.0	62.8	41.5				
70	0.59	1.4	6.00	0.91	0.93	0.83	0.0370	-0.019	24.5	70.0	47.8				
71	0.58	1.4	9.00	1.13	1.06	1.22	0.0852	-0.069	13.3	76.7	54.8				
72	0.58	1.3	0.0	0.06	0.05	0.06	0.0126	-0.015	7.8	26.1	0.6				
73	0.60	1.9	0.10	0.10	0.08	0.11	0.0129	-0.018							

APPENDIX A (CONT)

CONFIGURATION - 2, SC1095 AIRFOIL

RUN	MACH	RN	ALPH	CLP	CLPL	CL40	CDW	CMP	L/D	TOT T	STA T	LWC TIME	DIA FREQ	AMP	LNGTH	WIDTH	REMARKS
74	0.69	1.9	-2.00	-0.25	-0.28	-0.22	0.0180	-0.016	-13.8	26.1	0.1						
75	0.68	1.9	0.0	0.06	0.06	0.09	0.0130	-0.018	6.2	26.1	0.7						
76	0.68	1.9	3.00	0.60	0.61	0.41	0.0259	-0.024	23.1	26.1	0.8						
77	0.29	1.1	0.0	0.08	0.08	0.07	0.0100	-0.016	8.2	-7.2	-11.5						
78	0.29	1.1	6.00	0.80	0.75	0.76	0.0127	-0.023	62.8	-7.2	-11.6						
79																	
80	0.30	1.1	6.00	0.71	0.76	0.82	0.0769	-0.026	9.2	-7.2	-11.6	1.08	90.	20.	0.0	0.	UNKNOWN
81	0.39	1.4	0.0	0.08	0.09	0.08	0.0108	-0.015	7.9	-6.7	-14.7						POINT NOT STABLE
82																	
83	0.69	2.1	0.0	0.09	0.09	0.10	0.0128	-0.017	7.3	-1.1	-24.7						
84	0.73	2.2	0.0	0.11	0.10	0.12	0.0131	-0.019	8.2	-0.5	-26.7						
85	0.75	2.2	0.0	0.11	0.10	0.12	0.0145	-0.020	7.9	0.6	-27.1						
86	0.29	1.1	-6.00	-0.63	-0.63	-0.64	0.0133	-0.005	-47.6	-5.0	-9.4						
87	0.28	1.1	-6.00	-0.58	-0.63	-0.98	0.1137	0.031	-5.3	-7.2	-11.3	1.08	90.	20.	0.0	0.	UNKNOWN
																	SEE NOTE 1

CONFIGURATION - 8, NACA 0012 AIRFOIL(NO TAPS)

RUN	MACH	RN	ALPH	CLP	CLPL	CL40	CDW	CMP	L/D	TOT T	STA T	LWC TIME	DIA FREQ	AMP	LNGTH	WIDTH	REMARKS
88	0.29	1.1	0.0	-0.01	0.0080				-1.1	-12.0	-16.2						
89	0.29	1.1	3.00	0.33	0.0095				34.8	-10.0	-14.3						
90	0.29	1.1	6.00	0.68	0.0131				51.9	-10.0	-14.3						
91	0.29	1.1	9.00	1.01	0.0173				58.3	-11.0	-15.2						
92	0.29	1.1	12.00	1.30	0.0293				44.2	-10.0	-14.3						
93	0.29	1.1	6.00	0.64	0.0133				48.5	-10.0	-14.2						
94	0.29	1.1	6.00	0.60	0.0687				8.8	-11.0	-15.3	1.08	90.	20.	0.0	0.	UNKNOWN
95	0.29	1.1	6.00	0.61	0.0131				46.7	-9.8	-14.0						SEE NOTE 2
96	0.26	1.1	6.00	0.62	0.0682				9.1	-11.0	-15.1	1.08	90.	20.	0.0	0.	MODEL INVERTED
97	0.29	1.1	6.00	0.68	0.0131				51.7	-11.7	-16.0						MODEL INVERTED
98	0.29	1.1	6.00	0.62	0.0518				12.0	-11.7	-15.9	1.07	90.	20.	0.0	0.	UNKNOWN
99	0.29	1.1	6.00	0.66	0.0134				49.0	-11.7	-15.9						LESS CTR BAR FLO
100	0.28	1.1	6.00	0.63	0.0713				8.8	-11.7	-15.7	1.15	90.	20.	0.0	0.	UNKNOWN
101	0.29	1.1	0.0	0.00	0.0085				0.1	-11.7	-16.0						MORE CTR BAR FLO
102	0.27	1.0	0.0	-0.02	0.1820				-0.1	-11.7	-15.4	3.80	90.	20.	0.0	0.	UNKNOWN
																	100% CTR BAR FLO

CONFIGURATION - 7, CH-58 TAIL ROTOR

RUN	MACH	RN	ALPH	CLP	CLPL	CL40	CDW	CMP	L/D	TOT T	STA T	LWC TIME	DIA FREQ	AMP	LNGTH	WIDTH	REMARKS
103 TO 124	0.49	1.5	0.0	-0.04	0.0180				-2.2	-10.0	-21.9						NO DATA
125	0.49	1.5	-2.00	-0.23	0.189				-12.1	-10.0	-21.9						
126	0.49	1.5	0.0	-0.03	0.0178				-1.7	-10.0	-21.7						
127	0.48	1.5	0.0	0.31	0.0215				17.4	-10.0	-21.9						
128	0.49	1.5	3.00	0.65					30.2	-10.0	-22.0						
129	0.49	1.5	6.00														

APPENDIX A (CONT)

CONFIGURATION - 7, OH-58 TAIL ROTOR

RUN	MACH	RN	ALPH	CLP	CLPL	CL40	CDW	CMP	L/D	TOT T	STAT	LNC	TIME	DIA	FREQ	AMP	LENGTH	WIDTH	REMARKS
130	0.49	1.5	9.00	1.00	0.05	0.0439	22.8	-10.0	-22.1										
131	0.49	1.5	12.00	0.03	0.1109	8.5	-10.0	-22.1											
132	0.49	1.5	0.0	-0.03	0.0172	-1.9	-10.0	-21.9											
133	0.29	1.0	0.0	0.03	0.0160	1.9	-14.0	-16.4											
134	0.29	1.0	-2.00	-0.19	0.0165	-11.7	-14.0	-16.4											
135	0.29	1.0	0.0	-0.03	0.0154	-1.7	-14.0	-16.4											
136	0.30	1.0	3.00	0.27	0.0162	16.5	-14.0	-16.4											
137	0.30	1.0	6.00	0.57	0.0189	30.4	-14.0	-16.4											
138	0.30	1.0	9.00	0.83	0.0250	33.1	-14.0	-16.4											
139	0.30	1.0	12.00	1.08	0.0389	27.8	-14.0	-16.4											
140	0.30	1.0	13.00	0.86	0.1137	7.6	-14.0	-16.4											
141	0.30	1.0	14.00	0.80	0.2133	3.8	-14.0	-16.4											
142	0.30	1.0	15.00	0.83	0.1973	4.2	-14.0	-16.4											
143	0.30	1.0	16.00	0.84	0.1685	5.0	-14.0	-16.5											
144	0.30	1.0	0.0	-0.06	0.0157	-3.6	-14.0	-16.4											
145	0.39	1.3	0.0	-0.00	0.0169	0.1	-14.0	-21.6											
146	0.39	1.3	-2.00	-0.22	0.0162	-13.3	-14.0	-21.8											
147	0.39	1.3	0.0	-0.03	0.0165	-1.8	-14.0	-21.8											
148	0.40	1.3	3.00	0.30	0.0175	17.2	-14.0	-21.9											
149	0.39	1.3	6.00	0.61	0.0193	31.8	-14.0	-21.8											
150	0.39	1.3	9.00	0.91	0.0315	28.8	-14.0	-21.8											
151	0.40	1.3	12.00	0.94	0.1407	6.7	-14.0	-21.8											
152	0.39	1.3	13.00	0.88	0.1380	6.4	-14.0	-21.8											
153	0.40	1.3	14.00	0.88	0.1715	5.2	-14.0	-21.9											
154	0.39	1.3	15.00	0.84	0.1825	4.6	-14.0	-21.6											
155	0.39	1.3	0.0	0.00	0.0172	0.3	-14.0	-21.6											
156	0.58	1.8	0.0	-0.00	0.0164	-0.1	-14.0	-30.5											
157	0.59	1.8	-2.00	-0.27	0.0211	-12.8	-14.0	-30.8											
158	0.58	1.8	0.0	-0.05	0.0186	-2.6	-14.0	-30.3											
159	0.59	1.8	3.00	0.38	0.0233	16.5	-14.0	-30.6											
160	0.59	1.8	6.00	0.77	0.0509	15.2	-14.0	-30.8											
161	0.59	1.8	9.00	0.97	0.1045	9.3	-14.0	-30.8											
162	0.59	1.8	0.0	-0.04	0.0194	-2.2	-14.0	-30.6											
163	0.59	1.8	10.00	1.00	0.1174	8.5	-14.0	-30.7											
164	0.59	1.8	0.0	0.04	0.0190	2.2	-14.0	-30.7											
165	0.68	2.0	0.0	0.05	0.0239	2.0	-14.0	-35.8											
166	0.68	2.0	-2.00	-0.25	0.0329	-7.4	-14.0	-36.0											
167	0.69	2.0	0.0	-0.05	0.0242	-2.3	-14.0	-36.4											
168	0.69	2.0	3.00	0.40	0.0453	8.9	-14.0	-36.3											
169	0.65	1.9	6.00	0.74	0.0672	11.0	-14.0	-34.4											
170	0.69	2.0	0.0	0.06	0.0244	2.4	-14.0	-36.2											
171	0.72	2.1	0.0	0.07	0.0333	2.1	-14.0	-38.5											
172	0.74	2.1	0.0	-0.04	0.0242	-1.1	-14.0	-39.9											
173	0.75	2.1	0.0	-0.04	0.0390	-1.0	-14.0	-40.3											
174	0.30	1.0	6.00	0.61	0.0172	35.6	-14.0	-18.3											
175	0.30	1.0	6.00	0.41	0.1875	2.2	-8.9	-13.4	0.50	90.	20.	0.0	0.	0.44	UNKNOWN				
176	0.58	1.7	0.0	0.04	0.0181	2.2	0.0	-16.9											
177	0.58	1.7	0.0	0.04	0.0601	0.5	0.0	-17.1	0.29	45.	20.	0.0	0.	UNKNOWN					

APPENDIX A (CONT)

CONFIGURATION - 1, NACA 0012 AIRFOIL

RUN	MACH	RN	ALPH	CLP	CLPL	CL40	CDW	CMP	L/D	TOT T	STA T	LNC TIME	DIA FREQ	AMP	LNGLTH	WTOTH	REMARKS
176 TO 181																	NO DATA
182	0.29	1.1	-6.00	-0.69	-0.67	-0.82	0.0151	0.007	-45.9	-11.0	-15.4						
183	0.29	1.1	6.00	0.62	0.64	0.52	0.0140	-0.006	44.3	-2.2	-6.7						
184																	NO DATA
185	0.29	1.1	0.0	-0.01	-0.02	-0.04	0.0109	0.0	-0.9	0.0	-4.5						
186	0.30	1.1	6.00	0.68	0.65	0.66	0.0139	-0.008	48.8	0.0	-4.7						
187	0.29	1.1	0.0	0.03	-0.00	-0.06	0.0098	-0.017	2.7	0.0	-4.5						
188	0.29	1.1	-2.00	-0.23	-0.23	-0.33	0.0104	-0.011	-22.2	-3.3	-7.8						
189	0.29	1.1	0.0	-0.01	-0.01	-0.08	0.0095	-0.010	-1.2	-3.3	-7.8						
190	0.29	1.1	3.00	0.33	0.31	0.26	0.0105	-0.010	31.1	-3.3	-7.9						
191	0.30	1.1	5.89	0.66	0.68	0.61	0.0128	-0.014	51.6	-3.3	-7.9						
192	0.30	1.1	6.77	0.98	0.95	0.95	0.0168	-0.015	51.9	0.6	-4.1						
193	0.30	1.1	11.64	1.19	1.21	1.13	0.0281	-0.002	42.4	0.6	-4.2						
194	0.30	1.1	13.00	1.25	1.26	1.15	0.0377	-0.007	33.3	0.6	-4.1						
195	0.29	1.1	14.00	1.24	1.29	0.94	0.0578	-0.036	22.1	0.6	-4.1						
196	0.29	1.1	15.00	1.10	1.20	1.44	0.2018	-0.140	5.5	0.6	-4.0						
197	0.29	1.1	0.0	-0.00	0.00	-0.05	0.0094	0.0	-0.6	0.0	-4.6						
198	0.39	1.4	0.0	0.02	-0.02	-0.10	0.0101	-0.011	2.0	0.0	-6.0						
199	0.39	1.4	-2.00	-0.20	-0.21	-0.31	0.0107	-0.007	-19.0	0.0	-6.1						
200	0.39	1.4	0.0	-0.00	-0.03	-0.10	0.0095	-0.004	-0.1	0.0	-6.2						
201	0.39	1.4	3.00	0.34	0.32	0.27	0.0103	0.001	32.7	0.0	-6.1						
202	0.39	1.4	6.00	0.70	0.68	0.66	0.0131	-0.004	53.8	0.0	-6.3						
203	0.39	1.4	9.00	1.00	1.03	1.00	0.0197	0.007	50.9	0.0	-6.0						
204	0.39	1.4	11.00	1.15	1.20	1.06	0.0370	0.005	31.1	0.0	-6.2						
205	0.39	1.4	12.00	1.17	1.15	1.14	0.0632	-0.047	14.1	0.0	-6.2						
206	0.39	1.4	12.00	1.18	1.13	1.14	0.0766	-0.040	15.6	0.0	-6.2						
207	0.40	1.4	13.00	1.20	1.15	1.27	0.1427	-0.080	8.6	0.0	-6.3						
208	0.39	1.4	1.6	0.02	-0.04	-0.06	0.0103	-0.017	2.2	0.0	-6.1						
209	0.49	1.6	0.0	-0.02	-0.03	-0.06	0.0120	0.0	-1.2	0.0	-12.2						
210	0.49	1.7	-2.00	-0.27	-0.32	-0.34	0.0124	-0.004	-22.0	0.0	-12.4						
211	0.49	1.7	0.0	-0.03	-0.04	-0.09	0.0134	0.0	-2.3	0.0	-12.4						
212	0.49	1.7	3.00	0.36	0.36	0.33	0.0128	-0.003	28.1	0.0	-12.5						
213	0.49	1.7	6.00	0.68	0.74	0.53	0.0149	0.011	45.7	0.0	-12.4						
214	0.49	1.7	9.00	0.95	1.03	0.65	0.0400	0.017	23.8	0.0	-12.5						
215	0.49	1.7	11.00	1.05	1.12	0.72	0.0890	-0.006	11.7	0.0	-12.5						
216	0.49	1.7	12.00	1.09	1.13	0.99	0.1174	-0.030	9.3	0.0	-12.5						
217	0.49	1.6	0.0	-0.06	-0.05	0.0112	-0.010	0.4	0.0	-12.2							
218																	
219	0.59	1.9	-2.00	-0.27	-0.28	-0.38	0.0123	-0.008	-21.8	0.0	-17.6						
220	0.59	1.9	0.0	-0.04	-0.05	-0.12	0.0121	-0.004	-3.3	0.0	-17.6						
221	0.59	1.9	3.00	0.39	0.41	0.38	0.0123	-0.003	31.9	0.0	-17.6						
222	0.59	1.9	6.00	0.82	0.82	0.72	0.0293	0.005	28.1	0.0	-17.6						
223	0.59	1.9	9.00	1.08	1.09	0.93	0.0694	-0.003	15.6	1.7	-16.3						
224	0.59	1.9	10.00	1.10	1.08	1.06	0.0782	-0.022	14.1	1.7	-16.3						
225	0.59	1.9	0.0	-0.04	-0.02	-0.07	0.0113	0.004	-3.2	1.7	-15.7						
226	0.58	1.9															

APPENDIX A (CONT)

CONFIGURATION - 1, NACA 0012 AIRFOIL

RUN	MACH	RN	ALPH	CLP	CLPL	CL40	CDW	CMP	L/D	TOT T	STA T	LWC TIME	DIA FREQ	AMP LENGTH	WIDTH	REMARKS
227	0.68	2.1	0.0	-0.03	-0.02	-0.09	0.0129	0.002	-2.6	1.7	-21.5					
228	0.69	2.1	-2.00	-0.28	-0.26	-0.33	0.0144	0.003	-19.4	-0.5	-24.3					
229	0.69	2.1	0.0	-0.07	-0.06	-0.13	0.0118	0.002	-6.3	-0.5	-24.2					
230	0.69	2.1	3.00	0.40	0.41	0.33	0.0211	0.002	19.1	-0.5	-23.9					
231	0.65	2.1	6.00	0.82	0.84	0.68	0.0417	0.001	19.8	0.0	-21.5					
232	0.69	2.1	0.0	0.06	0.07	0.01	0.0117	0.001	5.2	0.0	-23.8					
233	0.73	2.2	0.0	0.07	0.09	0.00	0.0146	0.002	4.7	0.0	-26.1					
234	0.75	2.3	0.0	0.07	0.10	0.02	0.0202	0.0	3.7	0.0	-27.8					
235	0.59	1.9	6.00	0.79	0.81	0.72	0.0287	0.008	27.4	10.6	-6.2					
236	0.59	1.9	6.00	0.75	0.78	0.70	0.0351	0.009	21.4	10.6	-8.1	0.24	20.	0.0	0.25	
237	0.59	1.9	6.00	0.67	0.81	0.71	0.0270	-0.006	25.0	5.6	-12.6	0.24	60.	0.0	0.25	
238	0.59	1.9	6.00	0.69	0.79	0.69	0.0300	-0.003	22.9	5.6	-12.6	0.24	60.	0.0	0.25	
239	0.59	2.0	6.00	0.71	0.81	0.76	0.0343	-0.013	20.8	0.4	-17.6	0.24	60.	0.0	0.25	
240	0.48	1.7	6.00	0.77	0.76	0.68	0.0143	-0.009	53.8	-5.0	-16.9				0.38	
241	0.48	1.7	6.00	0.67	0.74	0.70	0.0303	-0.015	22.2	-5.0	-16.6	0.31	60.	0.0	0.25	

CONFIGURATION - 2, SC1095 AIRFOIL

RUN	MACH	RN	ALPH	CLP	CLPL	CL40	CDW	CMP	L/D	TOT T	STA T	LWC TIME	DIA FREQ	AMP LENGTH	WIDTH	REMARKS
242	0.29	1.1	0.0	0.08	0.08	0.10	0.0096	-0.017	8.3	0.0	-4.4					
243	0.29	1.1	0.0	0.08	0.06	0.09	0.0100	-0.016	7.7	0.0	-4.4					
244	0.29	1.1	9.00	1.13	1.12	1.10	0.0168	-0.023	67.4	0.0	-4.5					
245	0.29	1.1	11.00	1.31	1.26	1.25	0.0270	-0.020	48.4	0.0	-4.5					
246	0.29	1.1	12.00	1.37	1.38	1.30	0.0345	-0.020	39.6	0.0	-4.5					
247	0.29	1.1	12.50	1.42	1.45	1.32	0.0384	-0.020	36.9	0.0	-4.4					
248	0.29	1.1	13.00	1.41	1.41	1.32	0.0537	-0.030	26.2	0.0	-4.5					
249	0.29	1.1	13.50	1.34	1.29	1.47	0.1588	-0.111	8.5	0.0	-4.5					
250	0.29	1.1	0.0	0.10	0.09	0.11	0.0105	-0.019	9.3	0.0	-4.5					
251	0.59	2.0	0.0	0.09	0.07	0.09	0.0112	-0.015	7.7	0.0	-17.6					
252	0.29	1.1	6.00	0.77	0.77	0.77	0.0121	-0.025	63.9	-1.3	-5.9					
253	0.29	1.1	6.00	0.79	0.78	0.80	0.0138	-0.025	57.1	-7.0	-11.4					
254	0.27	1.0	6.00	0.67	0.63	0.86	0.1031	-0.034	6.5	-7.0	-10.9	0.78	60.	0.0	0.31 UNKNOWN	
255	0.58	1.9	6.00	0.92	0.92	0.85	0.0415	-0.019	22.1	10.0	-6.3					
256	0.58	1.9	6.00							10.0	-7.9	0.24	20.			
257	0.58	1.9	6.00							8.0	-9.7	0.24	20.			
258	0.58	1.9	6.00	0.86	0.89	0.81	0.0335	-0.021	25.7	5.7	-12.3	0.24	60.	0.0	0.19 BEAK	
259	0.58	2.0	6.00	0.88	0.91	0.93	0.0393	-0.030	22.5	0.4	-17.3	0.24	60.	0.0	UNKNOWN	
260	0.48	1.7	6.00	0.90	0.89	0.88	0.0170	-0.021	53.1	-5.0	-17.0					
261	0.48	1.7	6.00	0.85	0.88	0.79	0.0290	-0.029	29.2	-5.0	-17.0	0.30	60.	0.0	0.14 0.27	

NO ICE - NO DATA
SHEDDING LT. ICE

RUNS 262 TO 269 TUNNEL BOUNDARY LAYER INVESTIGATION. SEE FIGURE 21

CONFIGURATION - 4, VR-7 AIRFOIL

RUN	MACH	RN	ALPH	CLP	CLPL	CL40	CDW	CHP	L/D	TOT T	STA T	LNC TIME	DIA FREQ AMP	LNGTH	WIDTH	REMARKS
270	0.29	1.1	0.0	0.16	-0.04	0.0100	17.9	0.0	-4.5							
271	0.29	1.1	-2.00	0.11	0.0119	-3.5	0.0	-4.5								
272	0.29	1.1	0.0	0.55	0.0098	11.5	0.0	-4.4								
273	0.29	1.1	3.00	0.55	0.0083	66.0	0.0	-4.5								
274	0.29	1.1	6.00	0.97	0.0104	93.3	0.0	-4.5								
275	0.29	1.1	9.00	1.30	0.0195	66.0	0.0	-4.5								
276	0.29	1.1	12.00	1.44	0.0739	19.4	0.0	-4.5								
277	0.29	1.1	13.00	1.47	0.0806	18.2	0.0	-4.5								
278	0.29	1.1	14.00	1.67	0.1298	11.3	0.0	-4.5								
279	0.29	1.1	15.00	1.50	0.1490	10.1	0.0	-4.5								
280	0.29	1.1	0.0	0.16	0.0099	16.6	0.0	-4.5								
281	0.29	1.1	0.0	0.14	0.0095	15.1	0.0	-4.4								
282	0.39	1.5	0.0	0.21	0.0101	21.0	0.0	-6.0								
283	0.39	1.5	-2.00	-0.08	0.0111	-7.5	0.0	-7.8								
284	0.39	1.5	0.0	0.21	0.0105	20.4	0.0	-7.9								
285	0.39	1.5	3.00	0.62	0.0089	69.7	0.0	-7.6								
286	0.39	1.5	6.00	1.03	0.0103	99.9	0.0	-7.6								
287	0.39	1.5	9.00	1.39	0.0219	63.4	0.0	-6.0								
288	0.39	1.5	12.00	1.42	0.1080	13.1	0.0	-6.1								
289	0.39	1.5	11.00	1.45	0.0507	28.6	0.0	-6.0								
290	0.39	1.5	12.00	1.47	0.0960	15.3	0.0	-7.9								
291	0.39	1.5	13.00	1.39	0.1254	11.1	0.0	-8.0								
292	0.39	1.5	0.0	0.19	0.0100	19.0	0.0	-7.8								
293	0.49	1.8	0.0	0.21	0.0108	19.4	0.0	-12.3								
294	0.49	1.8	-2.00	-0.09	0.0125	-7.4	0.0	-12.3								
295	0.49	1.8	0.0	0.22	0.0104	20.9	0.0	-12.2								
296	0.49	1.8	3.00	0.69	0.0095	72.8	0.0	-12.4								
297	0.49	1.8	6.00	1.09	0.0113	96.8	0.0	-12.4								
298	0.49	1.8	9.00	1.51	0.0242	62.2	0.0	-12.4								
299	0.49	1.8	11.00	1.58	0.0273	58.0	0.0	-12.3								
300	0.49	1.8	12.00	1.57	0.0241	65.2	0.0	-12.3								
301	0.48	1.8	0.0	0.22	0.0114	19.6	0.0	-12.0								
302	0.58	2.1	0.0	0.23	0.0112	20.9	0.0	-17.3								
303	0.58	2.1	-2.00	-0.12	0.0139	-8.8	0.0	-17.4								
304	0.58	2.1	0.0	0.20	0.0108	18.5	0.0	-17.3								

APPENDIX A (CONT.)

CONFIGURATION - 4, VR-7 AIRFOIL

RUN	MACH	RN	ALPH	CLP	CLPL	CL40	CDA	CHP	L/D	TOT T	STA T	LWC TIME	DIA FREQ	AMP LENGTH	WIDTH	REMARKS
305	0.56	2.1	3.00		0.75		0.0102			73.4	0.0	-17.5				
306	0.56	2.1	6.00		1.23		0.0243			50.5	0.0	-17.5				ONLINE DATA ONLY
307	0.56	2.0	9.00		1.45		0.0359			40.3	0.0	-16.5				
308	0.57	2.0	0.0		0.22		0.0110			20.0	0.0	-16.7				
309	0.68	2.3	0.0		0.26		0.0166			15.7	0.0	-23.1				
310	0.69	2.3	-2.00		-0.13		0.0195			-6.9	0.0	-23.6				
311	0.68	2.3	0.0		0.23		0.0157			14.9	0.0	-23.0				
312	0.66	2.3	3.00		0.69		0.0270			25.7	0.0	-22.1				
313	0.68	2.3	0.0		0.25		0.0161			15.5	0.0	-23.3				ONLINE DATA ONLY
314	0.72	2.4	0.0		0.26		0.0278			9.4	0.0	-25.7				
315	0.68	2.3	0.0		0.25		0.0175			14.2	0.0	-23.3				
316	0.68	2.3	-2.00		-0.13		0.0188			-7.0	0.0	-23.3				
317	0.68	2.3	0.0		0.23		0.0159			14.5	0.0	-23.4				
318	0.67	2.3	3.00		0.69		0.0328			21.0	0.0	-22.4				
319	0.68	2.3	0.0		0.26		0.0167			15.7	0.0	-23.0				
320	0.71	2.4	0.0		0.25		0.0277			9.1	0.0	-25.2				
321	0.72	2.4	-2.00		-0.21		0.0282			-7.6	0.0	-25.9				
322	0.71	2.4	0.0		0.23		0.0255			6.9	0.0	-25.1				
323	0.79	1.1	0.0		0.20		0.0095			20.7	0.0	-4.4				
324	0.29	1.1	6.00		0.96		0.0110			87.2	0.0	-4.4				
325	0.29	1.1	6.00		0.96		0.0105			91.0	0.0	-4.4				
326	0.29	1.1	6.00		0.93		0.0316			29.4	0.0	-4.4				
327										20.	0.0	-0.15	RIME			NO DATA
328	0.29	1.1	6.00		0.96		0.0385			29.9	0.0	-4.4				NO ICE
329	0.29	1.1	6.00		0.98		0.0103			95.2	0.0	-4.4				LT. ICE, NO DATA
330	0.29	1.1	6.00		0.94		0.0500			18.7	0.0	-4.4				ICE SHED, NO DATA
331	0.28	1.1	6.00		1.01		0.0123			82.1	2.4	-2.0				LIGHT ICE
332	0.28	1.1	6.00							1.0	-3.2	0.66				
333	0.28	1.1	6.00							4.0	-0.8	0.66				
334	0.29	1.1	6.00		0.98		0.0247			39.7	0.6	-3.2				
335	0.29	1.1	6.00		0.93		0.0114			81.6	0.6	-3.9				
336	0.29	1.2	6.00		0.89		0.0356			25.1	-8.9	-13.2				
337	0.29	1.2	6.00		0.99		0.0111			89.1	-8.9	-13.3				
338	0.29	1.2	6.00		0.92		0.0552			16.6	-8.9	-13.2				
339										101.0	-8.9	-13.3				NO DATA
340	0.29	1.2	6.00		1.00		0.0099			26.3	-8.9	-13.2				
341	0.29	1.2	6.00		0.88		0.0333			23.3	-8.9	-13.5				
342	0.30	1.2	3.00		0.56		0.0242			31.0	-8.9	-13.0				
343	0.29	1.2	9.00		1.18		0.0379			89.9	-8.9	-13.3				
344	0.30	1.2	6.00		0.96		0.0107			22.1	-8.9	-13.3				
345	0.30	1.2	6.00		0.84		0.0381			16.6	-8.9	-13.4				
346	0.30	1.2	3.00		0.50		0.0299			22.7	-8.9	-13.3				
347	0.29	1.2	9.00		1.16		0.0510			60.0	-10.0	-8.2				
348	0.58	2.0	3.00		0.70		0.0117			42.4	10.0	-8.0				
349	0.58	2.0	6.00		1.18		0.0278			34.0	10.0	-8.1				
350	0.58	2.0	7.50		1.32		0.0390			6.2	-11.4	1.03				
351	0.58	2.0	6.00							20.						ONSET OF ICING

APPENDIX A (CONT.)

CONFIGURATION - 4, VR-7 AIRFOIL

RUN	HACH	RN	ALPH	CLP	CLPL	CL40	CDW	CMP	L/D	TOT T	STA T	LWC TIME	DIA FREQ	AMP	LENGTH	WIDTH	REMARKS
352	0.58	2.1	6.00		1.23		0.0287		43.0	0.0	-17.7	0.60	0.	20.	0.0	0.0	
353	0.51	1.9	6.00		0.74		0.1603		4.6	0.0	-13.7	1.03	120.	20.	0.0	0.	0.69 UNKNOWN
354	0.56	2.0	6.00		0.92		0.1268		7.2	0.0	-16.1	1.03	60.	20.	0.0	0.	0.41 UNKNOWN
355	0.58	2.1	3.00		0.78		0.0109		71.7	0.0	-17.7						
356	0.58	2.1	3.00		0.47		0.1233		3.6	0.0	-17.4	1.03	60.	20.	0.0	0.	UNKNOWN
357	0.59	2.1	6.00		1.13		0.0526		21.5	0.0	-18.0	1.03	20.	20.	0.0	0.	0.09 UNKNOWN
358	0.60	2.1	6.00		1.11		0.0870		12.8	0.0	-16.1	1.03	40.	20.	0.0	0.	0.19 UNKNOWN
359	0.58	2.1	6.00		1.02		0.0886		11.5	0.0	-17.4	1.03	65.	20.	0.0	0.	0.31 UNKNOWN
360	0.58	2.1	6.00		1.21		0.0275		44.0	0.0	-17.4						
361	0.58	2.1	6.00		0.88		0.1286		6.9	0.0	-17.3	1.03	60.	20.	0.0	0.	
362	0.58	2.1	3.00		0.70		0.0987		7.1	0.0	-17.3						
363	0.59	0.2	6.00		0.90		0.1228		0.8	0.0	-17.8						
364																	
365	0.43	1.6	6.00		0.80		0.1477		5.4	0.0	-9.6	1.28	60.	20.	5.0	5.	0.47 0.84 ICE FROM 361
366	0.48	1.8	9.00		0.90		0.1334		6.7	0.0	-11.8						ICE FROM 365
367	0.51	1.9	3.00		0.62		0.0684		9.1	0.0	-13.8						ICE FROM 365
368	0.53	1.9	0.0		0.20		0.0562		3.5	0.0	-14.9						ICE FROM 365

CONFIGURATION - 2, SC1095 AIRFOIL

RUN	MACH	RN	ALPH	CLP	CLPL	CL40	CDW	CMP	L/D	TOT T	STA T	LWC TIME	DIA FREQ	AMP	LNSTH WIDTH	REMARKS
369	0.29	1.0	6.00	0.77	0.73	0.68	0.0131	-0.021	58.4	20.0		15.1				
370	0.29	1.0	6.00	0.84	0.85	0.0136	-0.021	61.6	20.0			15.1				

三

371 TO 372
373
374 TO 379
380
381
382
383 TO 384
385
386

NO DATA	STATIC PRESSURE DATA AT WAKE PROBE ,	M=.3
NO DATA	STATIC PRESSURE DATA AT WAKE PROBE ,	M=.5
NO DATA	STATIC PRESSURE DATA AT WAKE PROBE ,	M=.7
NO DATA	TOTAL PRESSURE DATA AT WAKE PROBE ,	M=.3
NO DATA	TOTAL PRESSURE DATA AT WAKE PROBE ,	M=.5
NO DATA	TOTAL PRESSURE DATA AT WAKE PROBE ,	M=.7

APPENDIX A (CONT)

CONFIGURATION - 1, NACA 0012 AIRFOIL

RUN	MACH	RN	ALPH	CLP	CLPL	CL40	CDW	CNP	L/D	TOT T	STA T	LWC TIME	DIA FREQ	AMP LENGTH	WIDTH	REMARKS	
387																NO DATA	
388	0.33	1.2	8.00	0.91	0.86	0.88	0.0155	-0.007	58.7	10.0	4.0						
389	0.33	1.1	8.00	0.92	0.91	0.92	0.0160	-0.009	57.6	10.0	4.1						
390	0.36	1.3	8.00	0.93	0.93	0.92	0.0172	-0.005	56.1	10.0	2.0						
391	0.38	1.3	3.00	0.32	0.33	0.29	0.0102	-0.002	31.7	10.0	2.0						
392	0.39	1.3	4.00	0.48	0.46	0.44	0.0110	-0.004	43.6	10.0	1.9						
393	0.68	2.1	3.00	0.40	0.42	0.34	0.0163	0.001	24.8	10.0	-13.9						
394																NO DATA	
395																NO DATA	
396	0.67	2.1	3.50	0.45	0.51	0.40	0.0181	0.003	25.2	10.0	-13.2						
397	0.67	2.1	3.00	0.45	0.40	0.38	0.0140	0.001	32.3	10.0	-13.6						
398	0.59	1.9	6.00	0.81	0.81	0.70	0.0537	0.006	49.5	10.0	-6.4						
399	0.59	1.9	6.00													ONSET OF ICING SHEDDING ICE	
400	0.58	1.9	6.00	0.75	0.77	0.67	0.0395	0.011	18.8	6.0	-10.0	1.03	20.	0.0	0.0	0.0	
401	0.56	1.9	6.00	0.58	0.64	0.60	0.0861	-0.002	6.8	5.0	-11.7	1.03	45.	0.0	0.	UNKNOWN	
402	0.55	1.9	6.00	0.57	0.68	0.72	0.1089	-0.019	5.3	0.0	-15.8	1.03	60.	0.0	0.	UNKNOWN	
403	0.28	1.0	0.0	-0.02	0.07	-0.03	0.0093	0.003	-2.2	5.0	0.6					ONSET OF ICING	
404	0.29	1.1	0.0														
405	0.29	1.1	0.0	-0.03	-0.06	-0.10	0.0290	-0.010	-1.0	-1.0	-5.4	0.66	60.	0.0	0.	UNKNOWN	
406	0.29	1.1	0.0	-0.02	-0.05	-0.08	0.0330	0.004	-0.5	-5.0	-9.3	0.66	60.	0.0	0.	0.16 0.50	
407	0.29	1.1	0.0	-0.05	-0.07	-0.13	0.0253	0.016	-2.1	-5.0	-9.4	0.35	60.	0.0	0.	R/G	
408	0.29	1.1	0.0	-0.04	-0.07	-0.11	0.0206	0.006	-1.8	-10.0	-14.4	0.35	60.	0.0	0.	R/H	
409	0.28	1.1	0.0	-0.09	-0.08	-0.12	0.0165	-0.005	-0.2	-10.0	-14.2					PARTIAL ICE MELT	
410	0.29	1.1	0.0	-0.05	-0.05	-0.09	0.0253	0.011	-1.8	-10.0	-14.4	0.35	60.	0.0	0.	R/H	
411	0.29	1.1	0.0	0.00	-0.11	-0.16	0.0332	0.0	0.0	-10.0	-14.3	0.96	60.	0.0	0.	0.22 0.50	
412	0.27	1.1	0.0	-0.00	-0.06	-0.25	0.1260	-0.008	0.0	-10.0	-13.9	2.68	60.	0.0	0.	0.31 0.56	
413	0.29	1.1	2.96	0.32	0.35	0.27	0.0109	0.001	29.1	-5.0	-9.4						
414	0.29	1.1	2.95	0.32	0.33	0.38	0.0348	-0.002	9.3	-5.0	-9.4	0.66	60.	20.	0.0	0.19 0.50	
415	0.29	1.1	2.91	0.31	0.29	0.0122			24.8	-5.0	-9.4					ALUM. TAPE ON LE NO DATA, ALUM. T	
416																ALUM. TAPE ON LE ALUM. TAPE ON LE ALUM. TAPE ON LE	
417	0.28	1.1	2.92							5.1	-5.0	-9.2	0.66	60.	20.	0.0	0.13 0.38
418	0.28	1.1	2.94	0.30	0.362				7.1	-5.0	-9.2	0.66	60.	20.	0.0	0.16 0.38	

CONFIGURATION - 2, SC1095 AIRFOIL

RUN	MACH	RN	ALPH	CLP	CLPL	CL40	CDW	CNP	L/D	TOT T	STA T	LWC TIME	DIA FREQ	AMP LENGTH	WIDTH	REMARKS
419	0.29	1.1	-0.02	0.06	0.05	0.10	0.0098	-0.017	6.1	0.0	-4.4					BEAK
420	0.28	1.1	-0.01	0.03	0.02	0.03	0.0319	-0.017	1.0	0.0	-4.3	0.66	60.	20.	0.0	0.02 BEAK
421	0.28	1.0	-0.12	0.10	0.08	0.10	0.0098	-0.016	9.7	5.0	0.7					
422	0.29	1.0	-0.12	0.10	0.09	0.08	0.0093	-0.014	10.5	5.0	0.6					
423	0.29	1.1	0.0									0.5	-4.0	0.66	60.	20.
424	0.29	1.1	0.0	0.08	0.04	0.02	0.0283	-0.011	2.9	-5.0	-9.3	0.66	60.	20.	0.0	0.13 0.38
425	0.29	1.1	-0.17	0.08	0.07	-0.05	0.0102	-0.013	8.2	-10.0	-14.3					
426	0.29	1.1	0.0	0.07	0.05	0.09	0.0242	-0.012	3.1	-10.0	-14.3	0.66	60.	20.	0.0	0.09 RIME
427	0.29	1.1	-0.17	0.08	0.07	0.08	0.0091	-0.009	8.8	-10.0	-14.3					

APPENDIX A (CONT)

CONFIGURATION - 2, SC1095 AIRFOIL

RUN	MACH	RN	ALPH	CLP	CLPL	CL40	CDW	CMP	L/D	TOT T	STA T	LWC TIME	DIA FREQ	AMP LENGTH	WIDTH	REMARKS
428	0.29	1.1	-0.18	0.09	0.04	0.08	0.0300	-0.013	3.0	-10.0	0.96	60.	20.	0.	0.19	0.50
429	0.29	1.1	2.93	0.44	0.44	0.47	0.0099	-0.014	44.4	-10.0	-14.3					
430	0.29	1.1	2.90	0.42	0.41	0.47	0.0219	-0.020	19.0	-10.0	-14.3	0.35	60.	20.	0.	0.05 RIME
431	0.29	1.1	2.87	0.43	0.41	0.44	0.0086	-0.015	49.1	-5.0	-9.3					
432	0.29	1.1	2.87	0.40	0.42	0.41	0.0324	-0.015	12.4	-5.0	-9.3	0.66	60.	20.	0.	0.13 0.38
433	0.29	1.1	2.88	0.43	0.42	0.45	0.0272	-0.020	15.8	-5.0	-9.3	0.66	60.	20.	5.0	9.
434	0.29	1.1	5.91	0.69	0.70	0.71	0.0332	-0.022	20.8	-5.0	-9.2					
435	0.29	1.1	-0.03	0.08	0.14	0.08	0.0239	-0.016	3.4	-5.0	-9.4					
436	0.29	1.1	2.93	0.42	0.41	0.47	0.0206	-0.024	20.2	-10.0	-14.3	0.35	60.	20.	5.0	9.
437	0.29	1.1	5.91	0.69	0.69	0.71	0.0228	-0.020	30.1	-10.0	-14.1					
438	0.30	1.1	-0.05	0.05	0.05	0.03	0.0164	-0.012	3.3	-10.0	-14.4					
439	0.29	1.1	5.88	0.76	0.67	0.74	0.0110	-0.021	68.5	-10.0	-14.4					
440	0.30	1.1	5.88	0.69	0.69	0.72	0.0266	-0.022	26.0	-10.0	-14.4	0.35	60.	20.	0.	0.06 RIME
441	0.29	1.1	5.87	0.75	0.70	0.73	0.0109	-0.019	68.7	-5.0	-9.4					
442	0.29	1.1	5.87	0.66	0.73	0.56	0.0449	-0.018	14.7	-5.0	-9.3	0.66	60.	20.	0.	0.16 0.38
443	0.29	1.1	5.91	0.72	0.74	0.67	0.0370	-0.028	19.4	-5.0	-9.4	0.66	60.	20.	5.0	9.
444	0.28	1.0	8.86	0.90	0.96	0.78	0.0813	-0.024	11.0	-5.0	-9.0					
445	0.29	1.1	2.95	0.41	0.40	0.38	0.0280	-0.012	14.6	-5.0	-9.4					
446	0.29	1.1	6.16	0.82	0.77	0.76	0.0132	-0.023	61.8	-5.0	-9.5					
447	0.29	1.1	6.16	0.76	0.74	0.71	0.0391	-0.035	19.3	-5.0	-9.5	0.66	60.	20.	5.0	9.
448	0.28	1.0	0.0	0.93	0.98	0.90	0.0923	-0.037	10.1	-5.0	-9.0					
449	0.30	1.1	3.10	0.48	0.37	0.38	0.0288	-0.034	16.6	-5.0	-9.7					
450	0.39	1.4	6.00	0.74	0.75	0.69	0.0264	-0.026	27.8	-5.0	-12.9	0.48	60.	20.	5.0	9.
451	0.39	1.4														UNKNOWN

CONFIGURATION - 6, NACA 0012 AIRFOIL (NO TAPS)

RUN	MACH	RN	ALPH	CLP	CLPL	CL40	CDW	CMP	L/D	TOT T	STA T	LWC TIME	DIA FREQ	AMP LENGTH	WIDTH	REMARKS
452	0.40	1.5	6.00		0.61		0.0241		25.3	-10.0	-17.9	0.30	60.	20.	5.0	9.
453	0.40	1.5	6.00		0.61											NO DATA SEE ALSO RUN 570 NO DATA

CONFIGURATION - 4, VR-7 AIRFOIL

RUN	MACH	RN	ALPH	CLP	CLPL	CL40	CDW	CMP	L/D	TOT T	STA T	LWC TIME	DIA FREQ	AMP LENGTH	WIDTH	REMARKS
454	0.29	1.1	0.0	0.14			0.0106			13.1	0.0	-4.6				
455	0.29	1.1	3.00	0.51			0.0090			56.7	0.0	-4.6				
456	0.29	1.1	11.00	1.43			0.0455			31.5	0.0	-4.7				
457	0.29	1.1	12.00	1.45			0.0820			17.7	0.0	-4.5				
458	0.29	1.1	13.00	1.40			0.1294			10.8	0.0	-4.6				
459	0.29	1.1	14.00	1.41			0.1599			8.6	0.0	-4.6				
460	0.39	1.5	13.00	1.44			0.1667			6.6	0.0	-8.0				
461	0.49	1.8	6.00	1.46			0.0264			55.4	0.0	-12.7				
462	0.49	1.8	6.00	1.64			0.0454			36.2	0.0	-12.5				

CONFIGURATION - 4, VR-7 AIRFOIL

RUN	MACH	RN	ALPH	CLP	CLPL	CL40	CMP	L/D	TOT T	STA T	LWC TIME	DIA FREQ	AMP LENGTH	WIDTH	REMARKS
463	0.49	1.6	9.00	1.67	0.014	0.0168	0.0778	21.5	0.0	-12.5					
464	0.30	1.1	0.01	2.99	0.56	0.0130	0.0550	6.6	0.0	-4.8					
465	0.30	1.1	0.01	11.03	1.42	0.0856	0.1453	43.3	0.0	-6.7					
466	0.29	1.1	0.01	12.02	1.46	0.0208	0.2274	25.7	0.0	-4.6					
467	0.29	1.1	0.01	13.02	1.38	0.0254	0.2283	17.1	0.0	-4.5					
468	0.29	1.1	0.01	14.02	1.45	0.0281	0.283	6.4	0.0	-4.6					
469	0.29	1.1	0.01	15.02	1.36	0.0344	0.344	7.7	0.0	-4.7					
470	0.39	1.5	0.01	16.02	1.50	0.0218	0.344	78.6	0.0	-8.2					
471	0.49	1.6	6.03	1.08	0.0137	0.0208	0.208	67.2	0.0	-12.5					
472	0.49	1.6	8.01	1.40	0.0254	0.0254	0.254	56.3	0.0	-12.5					
473	0.49	1.6	9.01	1.48	0.0281	0.0281	0.281	52.2	0.0	-12.0					
474	0.48	1.7	10.03	1.50	0.0281	0.0281	0.281	53.5	0.0	-12.3					
475	0.49	1.6	11.04	1.54	0.0344	0.0344	0.344	44.8	0.0	-12.5					
476	0.49	1.6	12.03	1.54	0.0218	0.0218	0.218	53.3	0.0	-17.8					
477	0.59	2.1	6.03	1.16	0.0282	0.0282	0.282	46.7	0.0	-17.9					
478	0.59	2.1	8.00	1.32	0.0104	0.0104	0.104	13.9	0.0	-4.5					
479	0.29	1.1	0.02	0.14	0.17	0.002	0.002	5.4	0.0	-3.9					
480	0.29	1.1	0.00	0.18	0.13	0.0105	0.0105	12.0	-10.0	-14.5					
481	0.29	1.2	0.02	0.05	0.51	0.0083	0.0083	61.1	-10.0	-14.3					
482	0.29	1.2	0.03	0.11	0.0273	0.0273	0.273	3.6	-10.0	-14.4					
483	0.29	1.2	0.03	0.17	0.051	0.051	0.51	16.7	-10.0	-14.4					
484	0.29	1.2	0.08	0.45	0.0289	0.0289	0.289	61.1	-10.0	-14.3					
485	0.28	1.2	2.99	0.45	0.0205	0.0205	0.205	15.6	-10.0	-14.3					
486	0.28	1.2	2.99	1.04	0.0517	0.0517	0.517	65.9	-10.0	-14.4					
487	0.29	1.2	9.04	1.35	0.0517	0.0517	0.517	22.8	-10.0	-14.4					
488	0.29	1.2	9.05	1.17	0.0517	0.0517	0.517	65.2	-10.0	-14.4					
489	0.29	1.2	9.03	1.33	0.0204	0.0204	0.204	64.7	-10.0	-14.4					
490	0.38	1.5	9.05	1.40	0.0217	0.0217	0.217	29.6	-10.0	-17.6					
491	0.39	1.6	9.05	1.28	0.0434	0.0434	0.434	94.9	-10.0	-18.0					
492	0.38	1.5	6.01	1.02	0.0107	0.0107	0.107	27.1	-10.0	-17.5					
493	0.39	1.6	6.02	1.00	0.0369	0.0369	0.369	93.4	-10.0	-17.6					
494	0.48	1.9	6.03	1.10	0.0118	0.0118	0.118	93.4	-10.0	-21.8					
495	0.51	1.9	6.04	1.14	0.0194	0.0194	0.194	69.6	-10.0	-26.6					
496	0.59	2.2	6.06	1.35	0.0194	0.0194	0.194	9.4	-10.0	-26.6					
497	0.59	2.2	6.06	1.13	0.1051	0.1051	0.1051	89.0	-10.0	-21.7					
498	0.58	2.2	6.05	0.99	0.0126	0.0126	0.126	12.4	-10.0	-22.1					
499	0.48	1.9	5.83	1.12	0.0848	0.0848	0.848	107.8	-11.0	-23.0					
500	0.49	1.9	5.82	1.05	0.0108	0.0108	0.108	16.5	-11.0	-23.3					
501	0.49	1.9	5.79	1.16	0.0585	0.0585	0.585	94.1	-15.0	-26.5					
502	0.49	1.9	5.79	1.06	0.0116	0.0116	0.116	22.9	-15.0	-27.0					
503	0.49	1.9	5.79	1.09	0.0482	0.0482	0.482	93.9	-10.0	-17.6					
504	0.49	2.0	5.78	1.10	0.0114	0.0114	0.114	27.5	-10.0	-17.5					
505	0.39	1.6	5.73	1.07	0.0363	0.0363	0.363	65.9	-10.0	-26.5					
506	0.39	1.5	5.73	1.00	0.0193	0.0193	0.193	10.1	-10.0	-26.5					
507	0.58	2.2	5.76	1.27	0.1022	0.1022	0.1022	10.1	-10.0	-27.1					
508	0.58	2.2	5.76	1.03	0.1022	0.1022	0.1022	69.4	-10.0	-26.5					
509	0.59	2.1	5.76	0.75	0.0108	0.0108	0.108	6.3	-10.0	-26.5					
510	0.58	2.2	5.76	0.61	0.0969	0.0969	0.969	6.3	-10.0	-26.5					

CONFIGURATION - 1, NACA 0012 AIRFOIL

APPENDIX A (CONT.)

RUN	MACH	RN	ALPH	CLP	CLPL	CL40	CDM	CHP	L/D	TOT T	STA T	LNC TIME	DIA FREQ	AMP	LNGTH	WIDTH	REMARKS	
NO DATA																		
511	0.29	1.0	2.86	0.31	0.29	0.28	-0.004	-0.007	-5.0	-9.4								
512	0.29	1.0	2.86	0.31	0.27	0.26	-0.006	-0.007	-5.0	-9.4								
513	0.29	1.0	2.86	0.32	0.27	0.28	-0.003	-0.006	-5.0	-9.5								
514	0.28	1.0	2.86	0.32	0.30	0.26	0.0100	0.0	-1.6	-10.0	-14.3							
515	0.30	1.1	2.82	0.30	0.30	0.26	-0.006	-0.003	29.9	-5.0	-9.4							
516	0.29	1.1	-0.01	-0.02	-0.03	-0.06	0.0100	0.0	-0.001	29.9	-5.0	-9.4						
517	0.29	1.1	2.89	0.31	0.32	0.28	0.0104	-0.001	8.3	-5.0	-9.4							
518	0.29	1.1	2.87	0.30	0.29	0.26	0.0362	-0.001	38.8	-10.0	-26.9							
519	0.58	2.0	2.86	0.45	0.42	0.58	0.0116	-0.017	-10.0	-26.9	1.03	45.	20.	0.0	0.36	0.56		
520	0.56	2.0	2.86	0.26	0.36	0.37	0.1067	-0.008	-10.0	-25.9	20.	0.0	0.	0.36	0.56			
521	0.59	2.1	-0.06	-0.03	-0.03	-0.07	0.0103	0.003	-2.5	-10.0	-27.3							
522	0.58	2.0	-0.07	-0.01	-0.00	-0.06	0.0103	0.002	-1.1	-10.0	-26.9	1.03	45.	20.	0.0	0.44	0.56	
523	0.59	2.1	2.86	0.28	0.31	0.52	0.1184	-0.025	2.4	-10.0	-27.0							
524	0.68	2.3	2.88	0.45	0.45	0.38	0.0175	0.002	25.5	-10.0	-32.3							
525	0.67	2.3	1.45	0.25	0.25	0.20	0.0113	0.001	124.2	-10.0	-31.7							
526	0.67	2.3	-0.02	0.01	-0.01	-0.05	0.0137	1.1	-10.0	-31.7								
527	0.68	2.3	-0.02	-0.07	-0.02	-0.01	-0.008	0.003	-10.0	-32.5	1.20	45.	20.	0.0	0.50	0.63		
528	0.68	2.3	-0.07	-0.02	-0.01	-0.07	-0.001	-0.001	-10.0	-32.5	0.16	50.	20.	0.0	0.19	0.06		
529	0.68	2.3	-0.07	-0.02	0.00	-0.07	-0.001	0.003	-10.0	-32.3	0.16	50.	20.	0.0	0.19	0.06		
530	0.69	2.3	-0.08	-0.02	-0.01	-0.06	-0.001	0.003	-10.0	-32.6	0.35	45.	20.	0.0	0.25	0.28		
531	0.68	2.3	-0.08	-0.01	-0.02	-0.08	-0.006	-0.006	-10.0	-32.4	0.35	45.	20.	0.0	0.25	0.28		
532	0.68	2.3	-0.07	-0.04	-0.04	-0.08	0.0103	0.0	-4.2	-10.0	-32.4	0.35	45.	20.	0.0	0.16	0.22	
533	0.68	2.3	-0.08	-0.04	-0.04	-0.10	0.0209	0.004	-2.0	-10.0	-32.4	0.35	45.	20.	0.0	0.16	0.22	
534	0.68	2.3	1.47	0.14	0.18	0.11	0.0189	0.001	7.6	-10.0	-32.7							
535	0.48	1.7	5.62	0.74	0.73	0.71	0.0128	-0.002	57.5	-10.0	-21.6	0.94	20.	20.	0.0	0.09	0.19	
536	0.48	1.7	5.82	0.67	0.72	0.65	0.0349	0.002	19.2	-10.0	-21.6	0.94	20.	20.	0.0	0.09	0.19	
537	0.48	1.8	5.79	0.73	0.74	0.70	0.0142	-0.002	51.8	-10.0	-21.7							
538	0.47	1.7	5.78	0.54	0.64	0.61	0.0928	-0.012	5.8	-10.0	-21.3	0.94	45.	20.	0.0	0.19	0.28	
539	0.49	1.8	5.76	0.72	0.73	0.69	0.0147	0.0	49.2	-10.0	-22.0							
540	0.48	1.8	5.76	0.52	0.60	0.87	0.1224	-0.033	4.3	-10.0	-21.6	0.94	60.	20.	0.0	0.34	0.47	
541	0.49	1.8	5.99	0.75	0.76	0.72	0.0141	0.0	53.3	-10.0	-22.0							
542	0.49	1.8	5.99	0.75	0.76	0.72	0.0141	0.0	-10.0	-22.0	0.66	60.	20.	0.0	0.22	0.34		
543	0.29	1.1	6.02	0.68	0.66	0.65	0.0137	-0.004	49.5	-10.0	-14.3							
544	0.28	1.1	6.03	0.60	0.63	0.61	0.0493	0.001	12.1	-10.0	-14.2							
545	0.38	1.4	5.99	0.70	0.69	0.68	0.0137	-0.005	51.2	-10.0	-17.7							
546	0.38	1.4	6.00	0.58	0.61	0.59	0.0471	0.0	12.7	-10.0	-17.5	0.48	60.	20.	0.0	0.19	0.31	
547	0.39	1.5	6.01	0.69	0.68	0.68	0.0132	-0.002	52.3	-10.0	-17.9	0.48	60.	20.	0.0	0.19	0.31	
548	0.39	1.4	6.00	0.61	0.67	0.63	0.0369	-0.002	16.6	-10.0	-17.6	0.48	60.	20.	5.0	9.	0.09	0.20
549	0.39	1.4	9.02	0.83	0.89	0.85	0.0666	-0.017	12.9	-10.0	-17.9							
550	0.39	1.5	9.02	0.86	0.93	0.84	0.0666	-0.007	15.6	-10.0	-17.6							
551	0.38	1.4	3.00	0.36	0.32	0.35	0.0229	-0.004	15.6	-10.0	-17.6							
552	0.38	1.4	0.0	-0.02	-0.03	-0.06	0.0101	0.002	-1.6	-10.0	-17.6							
553	0.39	1.5	4.01	0.47	0.45	0.45	0.0108	-0.003	43.5	-10.0	-17.9							
554	0.39	1.5	8.00	0.92	0.93	0.90	0.0155	-0.002	59.3	-10.0	-17.9							

APPENDIX A (CONT)

CONFIGURATION - 8, NACA 0012 AIRFOIL (NO TAPS)

RUN	MACH	RN	ALPH	CLP	CLPL	CL40	CDW	CMP	L/D	TOT T	STA T	LWC TIME	DIA FREQ	AMP LENGTH	WIDTH	REMARKS
555	0.59	2.0	0.00	0.01	0.02	-0.01				-10.0	-27.3					NO DATA
556	0.59	2.0	0.00	0.01	0.02	-0.01				-10.0	-27.3					ONLINE DATA ONLY
557	0.59	2.0	0.00	0.01	0.02	-0.01	0.0159		-0.6	-12.3	-28.1					NO DATA
558	0.57	2.0	-0.12	-0.01			SEE RUN 1165			-10.0	-26.1	0.58	38.	20.	0.0	0.27 0.53
559	0.57	2.0	-0.12	-0.01			SEE RUN 1165			51.5	-10.0	-17.9				SEE ALSO RUN 548
560	0.39	1.4	6.00	0.70	0.0137					17.3	-10.0	-17.8	0.48	60.	20.	5.0 9. 0.08 0.20
561	0.39	1.4	9.00	0.69	0.0399					8.2	-10.0	-18.0				ICE FROM 561
562	0.39	1.5	9.02	0.85	0.1027					15.6	-10.0	-18.0				ICE FROM 561
563	0.39	1.5	2.99	0.43	0.0276											

CONFIGURATION - 1, NACA 0012 AIRFOIL

RUN	MACH	RN	ALPH	CLP	CLPL	CL40	CDW	CMP	L/D	TOT T	STA T	LWC TIME	DIA FREQ	AMP LENGTH	WIDTH	REMARKS
564	0.58	2.0	6.00	0.89	0.97	0.79	0.0372	0.002	24.0	-10.0	-27.0					
565	0.58	2.0	6.00	0.69	0.87	0.67	0.0562	-0.036	12.3	-10.0	-27.2	1.03	45.	20.	0.0 0. 0. 0.26 0.47	ICE FROM 565
566	0.58	2.0	6.98	0.78	0.90	0.758	-0.040	10.4	-10.0	-27.0						ICE FROM 565
567	0.58	2.0	2.97	0.40	0.58	0.398	-0.033	10.0	-10.0	-27.0						ICE FROM 565
568	0.59	2.0	-0.02	0.07	0.06	0.11	0.0502	-0.027	1.4	-10.0	-27.0					
569	0.39	1.4	5.98	0.70	0.72	0.69	0.0129	-0.006	54.0	-10.0	-17.9					
570	0.39	1.4	5.98	0.66	0.66	0.0277	-0.010	23.5	-10.0	-17.7	0.30	60.	20.	5.0 9. 0.09 ROUND	ICE FROM 570	
571	0.39	1.5	9.04	0.88	0.92	0.88	0.0424	-0.008	20.6	-10.0	-18.0					ICE FROM 570
572	0.39	1.4	2.97	0.35	0.37	0.35	0.0181	-0.009	19.3	-10.0	-17.9					ICE FROM 570
573	0.39	1.4	-0.01	0.02	-0.01	-0.01	0.0160	-0.003	1.3	-10.0	-17.8					ICE FROM 570
574	0.34	1.5	9.03	1.03	1.08	0.99	0.0190	0.002	37.5	-12.2	-18.2					ONLINE DATA ONLY
575	0.39	1.5	9.03	0.86	0.98	0.91	0.0369	-0.010	23.4	-10.0	-18.0					
576	0.29	1.1	9.05	0.99	0.95	0.99	0.0185	-0.002	53.5	-10.0	-14.4					
577	0.28	1.1	9.05	0.82	0.80	0.79	0.0679	-0.007	12.1	-10.0	-14.3	0.66	60.	20.	0.0 0. 0.16 ROUND	
578	0.29	1.1	6.01	0.68	0.66	0.67	0.0126	-0.008	53.9	-10.0	-14.4					
579																NO DATA
580	0.29	1.1	3.01	0.32	0.32	0.30	0.0313	-0.002	11.0	-10.0	-14.4	0.66	60.	20.	0.0 0. 0.28 0.38	
581	0.30	1.1	3.02	0.36	0.32	0.31	0.0094	0.004	37.7	-10.0	-14.5					
582	0.29	1.1	3.00	0.31	0.31	0.24	0.0259	0.004	11.8	-10.0	-14.5	0.66	60.	20.	5.0 9. 0.16 ROUND	
583																NO DATA
584	0.59	2.0	-0.09	-0.06	-0.05	0.04	0.0510	-0.014	-1.2	-10.0	-27.3	1.03	45.	20.	5.0 9. 0.36 0.50	
585																
CONFIGURATION - 2, SC1095 AIRFOIL																
RUN	MACH	RN	ALPH	CLP	CLPL	CL40	CDW	CMP	L/D	TOT T	STA T	LWC TIME	DIA FREQ	AMP LENGTH	WIDTH	REMARKS
586	0.29	1.1	-0.01	0.08	0.02	0.10				-0.009	-10.0	-14.3				
587	0.29	1.1	-0.05	0.09	0.03	0.08	0.0094	-0.014	9.5	-10.0	-14.4					
588	0.29	1.1	-0.07	0.07	0.07	0.05	0.0094	-0.009	7.6	-10.0	-14.4					
589	0.58	2.1	-0.08	0.08	0.06	0.08	0.0106	-0.013	7.6	-10.0	-26.5					

APPENDIX A (CONT)

CONFIGURATION - 2, SC1095 AIRFOIL

RUN	MACH	RN	ALPH	CLP	CLPL	CL40	CDW	CWP	L/D	TOT T	STA T	LAC TIME	DIA FREQ	AMP LENGTH	WIDTH	REMARKS		
590	0.56	2.0	-0.08	0.03	0.04	-0.14	0.0903	-0.004	0.3	-10.0	-25.5	1.03	45.	20.	0.0	0.44	0.56	
591	0.58	2.1	2.99	0.43	0.46	0.61	0.0949	-0.026	4.6	-10.0	-26.9						ICE FROM 590	
592	0.57	2.1	6.00	0.72	0.65	1.04	0.1082	-0.088	6.7	-10.0	-26.6						ICE FROM 590	
593	0.59	2.1	-0.08	0.09	0.06	0.10	0.0104	-0.012	8.4	-10.0	-27.0							
594	0.58	2.1	-0.04	0.03	0.06	0.09	0.0947	-0.019	0.3	-10.0	-26.4	1.03	45.	20.	5.0	9.	0.34	0.59
595	0.58	2.1	3.00	0.36	0.40	0.78	0.1230	-0.086	3.1	-10.0	-26.7						ICE FROM 594	
596	0.57	2.1	6.00	0.58	0.56	0.89	0.1355	-0.127	4.3	-10.0	-26.5						ICE FROM 594	
597	0.57	2.1	3.00	0.57	0.52	0.56	0.0133	-0.019	48.3	-10.0	-26.5							
598	0.56	2.0	3.00	0.40	0.46	0.45	0.1125	-0.024	3.6	-10.0	-25.8	1.03	45.	20.	0.0	0.	0.44	0.56
599	0.58	2.1	6.03	0.95	0.95	0.85	0.1394	-0.018	24.1	-10.0	-27.2						ICE FROM 600	
600	0.58	2.1	6.03	0.72	0.91	0.87	0.0642	-0.048	11.2	-10.0	-27.3	1.03	45.	20.	0.0	0.	0.38	0.56
601	0.57	2.1	9.00	0.91	1.03	1.03	0.1103	-0.081	8.3	-10.0	-26.9						ICE FROM 600	
602	0.57	2.1	3.01	0.44	0.51	0.53	0.0575	-0.038	7.7	-10.0	-26.5						ICE FROM 600	
603	0.60	2.1	0.01	0.07	0.05	0.03	0.0934	-0.022	27.8	-9.3	-26.8						ICE FROM 600	
604	0.67	2.3	-0.01	0.14	0.11	0.15	0.0108	-0.016	12.6	-10.0	-31.9							
605	0.67	2.3	0.0	0.11	0.10	0.14	0.0202	-0.018	5.2	-10.0	-31.6	1.20	45.	20.	0.0	0.	UNKNOWN	ONE SPRAY BAR
606	0.65	2.3	1.51	0.22	0.33	0.32	0.0213	-0.032	10.4	-10.0	-30.7						ICE FROM 605	
607	0.70	2.3	-0.10	0.09	0.06	0.11	0.0123	-0.014	7.2	-10.0	-33.1							
608	0.67	2.3	-0.09	0.06	0.05	0.10	0.0248	-0.017	2.5	-10.0	-31.8	0.35	45.	20.	0.0	0.	0.38	0.22 THREE SPRAY BARS
609	0.67	2.3	1.48	0.31	0.31	0.36	0.0257	-0.017	11.8	-10.0	-31.9						ICE FROM 608	
610	0.68	2.3	-0.02	0.11	0.10	0.14	0.0192	-0.015	5.9	-10.0	-32.0	0.35	30.	20.	0.0	0.	0.09	0.16
611	0.68	2.3	-0.01	0.13	0.10	0.14	0.0119	-0.017	11.1	-10.0	-31.9							
612	0.68	2.3	0.0	0.12	0.09	0.14	0.0177	-0.016	6.8	-10.0	-32.0	0.16	45.	20.	0.0	0.	0.16 ROUND	ICE FROM 612
613	0.68	2.3	1.47	0.33	0.33	0.36	0.0175	-0.023	18.9	-10.0	-32.4						ICE FROM 612	
614	0.67	2.3	2.98	0.52	0.62	0.56	0.0255	-0.036	20.4	-10.0	-32.2						ICE FROM 612	
615	0.58	2.0	-0.91	0.12	0.10	0.14	0.0167	-0.014	8.3	-10.0	-26.5							
616	0.59	2.0	6.00	0.95	0.94	0.85	0.0369	-0.020	25.7	0.0	-17.4							
617	0.58	2.0	5.99	0.90	0.93	0.95	0.0369	-0.033	24.4	0.0	-17.3	0.24	60.	20.	0.0	0.	0.16 BEAK	
618	0.58	2.1	6.03	0.96	0.94	0.87	0.0412	-0.021	23.3	-10.0	-26.8							
619	0.59	2.1	6.03	0.96	0.98	0.96	0.0378	-0.029	25.4	-10.0	-27.3	0.24	60.	20.	0.0	0.	0.16 RIME	ONLINE DATA ONLY
620	0.60	2.0	6.04	0.97	1.01	0.86	0.0351	-0.018	17.1	-10.0	-26.5	-3.6						
621	0.58	2.0	6.05	0.94	0.94	0.89	0.0364	-0.032	25.7	-5.0	-21.8	0.24	60.	20.	0.0	0.	0.25	0.38
622	0.59	2.1	6.06	0.98	0.95	0.87	0.0365	-0.019	26.7	-15.0	-31.6							
623	0.59	2.1	6.06	0.96	0.98	0.94	0.0351	-0.026	27.5	-15.0	-31.5	0.24	60.	20.	0.0	0.	0.19 RIME	
624	0.58	2.1	6.08	0.97	0.95	0.87	0.0381	-0.019	25.5	-10.0	-26.6							
625	0.59	2.1	6.07	0.98	0.97	0.87	0.0404	-0.023	24.1	-10.0	-26.9	0.24	20.	20.	0.0	0.	0.03 RIME	
626	0.58	2.1	6.08	0.97	0.95	0.87	0.0372	-0.019	26.1	-10.0	-26.6	0.24	60.	20.	0.0	0.	0.09 RIME	
627	0.58	2.1	6.08	0.98	0.98	0.95	0.0365	-0.025	26.9	-10.0	-27.0							
628	0.58	2.1	6.08	0.98	0.98	0.94	0.0352	-0.018	27.8	-15.0	-31.1							
629	0.59	2.1	6.10	0.79	0.96	0.91	0.0447	-0.055	17.5	-15.0	-31.1	1.03	60.	20.	0.0	0.	0.56	0.38
630	0.59	2.1	6.11	0.96	0.96	0.87	0.0392	-0.019	24.6	-10.0	-26.9							
631	0.59	2.1	6.12	0.93	0.97	0.93	0.0371	-0.023	25.1	-10.0	-27.0	1.03	20.	20.	0.0	0.	0.25	0.38
632	0.59	2.1	6.12	0.97	0.96	0.86	0.0385	-0.019	25.2	-10.0	-27.0							
633	0.59	2.1	6.13	0.67	0.89	0.76	0.0811	-0.050	8.3	-10.0	-27.0	1.03	60.	20.	0.0	0.	0.59	0.38
634	0.58	2.2	6.12	0.98	0.94	0.87	0.0398	-0.019	24.6	-20.0	-36.1	1.03	60.	20.	0.0	0.	0.68	0.47
635	0.59	2.2	6.13	0.92	1.00	0.92	0.0344	-0.037	26.7	-20.0	-36.4							
636	0.58	2.1	6.08	0.96	0.94	0.86	0.0371	-0.021	25.9	-10.0	-26.3							

APPENDIX A (CONT)

CONFIGURATION - 2, SC1095 AIRFOIL

RUN	MACH	RN	ALPH	CIP	CPL	CL40	CDW	CNP	L/D	TOT T	STA T	LMC TIME	DIA FREQ	AMP LENGTH	WIDTH	REMARKS
637	0.58	2.0	6.08	0.88	0.96	0.91	0.0359	-0.038	24.6	-10.0	-26.4	0.24	120.	20.	0.0	R/G
638	0.58	2.1	6.92	1.05	1.17	1.11	0.0492	-0.054	21.4	-10.0	-26.6					ICE FROM 637
639	0.58	2.1	2.89	0.56	0.54	0.59	0.0208	-0.027	26.9	-10.0	-26.6					ICE FROM 637
640	0.58	2.1	6.13	0.96	0.95	0.86	0.0361	-0.020	26.7	-10.0	-26.4					
641	0.58	2.1	6.13	0.92	0.98	0.92	0.0389	-0.042	24.4	-10.0	-26.4	1.95	45.	20.	0.0	NON-UNIFORM ICE
642	0.59	2.1	6.11	0.96	0.97	0.87	0.0399	-0.022	24.1	-10.0	-26.9					
643	0.59	2.1	6.11	0.93	1.00	0.93	0.0366	-0.033	25.5	-10.0	-27.0	1.00	45.	20.	0.0	0.28
644	0.59	2.1	6.00	0.98	0.97	0.88	0.0394	-0.019	25.0	-10.0	-26.9					0.38
645	THREE SPRAY BAR CALIBRATIONS SINGLE SPRAY BAR CALIBRATIONS															
646	TO 651	1.1	9.05	1.16	1.10	1.08	0.0172	-0.020	67.2	-10.0	-14.4					
652	0.29	1.1	9.04	0.93	0.98	0.89		-0.018		-10.0	-14.4	0.66	60.	20.	0.0	0.13
653	0.29	1.1	9.04	0.93	0.98	0.89		-0.021		-10.0	-17.7					0.25
654	0.39	1.5	9.05	1.22	1.18	1.15		-0.021		-10.0	-17.7					
655	0.37	1.4	9.05	0.88	0.92	1.00		-0.043		-10.0	-16.9	0.62	60.	20.	0.0	0.22
656	0.39	1.5	6.02	0.85	0.82	0.83		-0.023		-10.0	-17.8					0.31
657	0.39	1.5	6.02	0.74	0.76	0.76		-0.022		-10.0	-17.6	0.62	60.	20.	0.0	0.25
658	0.39	1.5	6.01	0.83	0.79	0.81		-0.022		-10.0	-17.6					0.38
659	0.38	1.5	6.00	0.71	0.76	0.72		-0.020		-10.0	-17.4	0.62	60.	20.	5.0	9.
660	0.39	1.5	9.02	0.94	0.98	1.03		-0.059		-10.0	-17.8					0.28 ROUND
661	0.39	1.5	3.01	0.44	0.44	0.45		-0.022		-10.0	-17.7					ICE FROM 659
662	0.39	1.5	0.0	0.12	0.08	0.10		-0.012		-10.0	-17.6					ICE FROM 659
663	0.48	1.8	6.01	0.92	0.88	0.89		-0.021		-10.0	-21.7					ICE FROM 659
664	0.49	1.8	6.02	1.15	1.13	1.08	0.0167	-0.027		-10.0	-22.0	0.53	60.	20.	0.0	0.28
665	0.29	1.1	9.02	0.93	0.93	0.93	0.0687	-0.025	69.2	-10.0	-14.3					0.34
666	0.29	1.1	8.99	0.93	1.06	0.93	0.0687	-0.025	19.1	-10.0	-14.3	0.66	60.	20.	0.0	0.13
667	0.39	1.5	8.99	1.21	1.14	0.0184	-0.018	66.0	-10.0	-17.8					0.25	
668	0.39	1.5	8.97	0.95	1.04	0.99	0.0662	-0.041	14.6	-10.0	-17.8	0.62	60.	20.	0.0	0.22
669	0.39	1.5	8.94	1.20	1.20	1.11	0.0181	-0.019	66.6	-10.0	-17.8					0.31
670	0.39	1.5	6.00	0.87	0.83	0.83	0.0129	-0.025	67.3	-10.0	-17.7					
671	0.39	1.5	5.99	0.75	0.76	0.80	0.0355	-0.020	22.1	-10.0	-17.6	0.62	60.	20.	0.0	0.25
672	0.39	1.5	5.98	0.86	0.87	0.83	0.0112	-0.024	87.3	-10.0	-17.8					0.38
673	0.39	1.5	5.98	0.76	0.76	0.76	0.0260	-0.033	34.8	-10.0	-17.8	0.62	60.	20.	5.0	9.
674	0.36	1.4	8.44	0.93	0.53	1.02	0.0665	-0.055	16.0	-10.0	-16.7					ICE FROM 673
675	0.39	1.5	3.00	0.46	0.57	0.48	0.0187	-0.024	26.6	-10.0	-17.8					ICE FROM 673
676	0.39	1.5	-0.01	0.16	0.37	0.17	0.0186	-0.013	9.3	-10.0	-17.7					ICE FROM 673
677	0.49	1.8	6.01	0.91	2.54	0.88		-0.021		-10.0	-21.9					
678	0.48	1.8	6.01	0.79	2.33	0.87		-0.029		-10.0	-21.8	0.53	60.	20.	0.0	0.28
679	0.29	1.1	5.97	0.83	0.88	0.79		-0.024		-10.0	-14.3					0.34
680	0.29	1.1	5.98	0.82	0.90	0.79		-0.023		-10.0	-14.2					
681	0.29	1.1	5.97	0.83	1.01	0.80	0.0134	-0.025	72.4	-10.0	-14.4	0.66	60.	20.	0.0	0.16 ROUND
682	0.29	1.1	5.97	0.71	0.91	0.71	0.0369	-0.022	18.3	-10.0	-14.4					
683	0.49	1.8	5.97	0.92	0.92	0.88	0.0138	-0.023	72.8	-10.0	-22.0					
684	0.49	1.8	5.96	0.82	0.87	0.87	0.0250	-0.032	38.5	-10.0	-22.0	0.36	60.	20.	0.0	UNKNOWN
685	0.29	1.1	3.00	0.50	0.46	0.48	0.0187	-0.023		-10.0	-14.3					
686	0.29	1.1	3.00	0.44	0.39	0.213	-0.019	22.8	-10.0	-14.3	0.66	60.	20.	0.0	0.16 ROUND	
687	0.29	1.1	3.00	0.46	0.42	0.299	-0.023	15.9	-10.0	-14.4					ICE FROM 686	
688	0.29	1.1	3.06	0.48	1.11	0.46	0.0068	-0.016	54.3	-10.0	-14.4					

APPENDIX A (CONT)

CONFIGURATION - 2, SC1095 AIRFOIL

RUN	HACH	RN	ALPH	CLP	CLPL	CL40	CDW	CHP	L/D	TOT T	STA T	LWC TIME	DIA FREQ	AMP LENGTH	WIDTH	REMARKS
689	0.29	1.1	6.01	0.61	1.16	0.77	0.0115	-0.025	70.7	-10.0	-14.3	0.6	-3.9	0.35	20.	ONSET OF ICING
690	0.29	1.1	6.00							1.0	-3.5	0.50	20.			ONSET OF ICING
691	0.29	1.1	6.00							0.9	-3.6	0.84	20.			ONSET OF ICING
692	0.29	1.1	6.00							0.8	-3.7	1.34	20.			ONSET OF ICING
693	0.29	1.1	6.00							0.7	-3.8	1.74	20.			ONSET OF ICING
694	0.28	1.1	6.01	0.73	0.92	0.47	0.0398	-0.020	18.4	-2.0	-6.3	0.50	20.	0.0	0.	0.06 BEAK
695	0.29	1.1	6.02	0.72	0.86	0.47	0.0393	-0.026	18.4	-4.0	-8.3	0.50	20.	0.0	0.	0.09 0.31
696	0.40	1.5	5.97	0.87	0.79	0.82	0.0125	-0.035	77.8	-10.0	-18.0					
697	0.40	1.5	5.96	0.71	0.79	0.63	0.0504	-0.023	14.1	-10.0	-17.9	0.62	20.	0.0	0.	0.25 0.38
698	0.40	1.5	5.95	0.69	0.73	0.72	0.0366	-0.021	19.0	-10.0	-17.9	0.62	20.	0.0	0.	0.25 0.38
699	0.40	1.5	5.96	0.70	0.74	0.74	0.0310	-0.022	22.7	-10.0	-17.9					ICE FROM 698
700	0.40	1.5	8.97	0.97	1.05	0.92	0.0615	-0.024	15.7	-10.0	-17.9					ICE FROM 698
701	0.39	1.5	6.03	0.73	0.75	0.77			-0.026	-10.0	-17.6	0.62	20.	0.0	0.	0.25 0.38
702	0.39	1.5	6.04	0.73	0.70	0.78	0.0408	-0.020	17.8	-10.0	-17.5	0.62	20.	0.0	0.	0.25 0.38
703	0.40	1.5	8.97	0.93	0.96	1.04	0.0835	-0.051	11.4	-10.0	-17.8					ICE FROM 702
704	0.40	1.5	3.00	0.44	0.45	0.46	0.0219	-0.022	20.0	-10.0	-17.6					ICE FROM 702
705	0.40	1.5	-0.04	0.13	0.08	0.12	0.0206	-0.015	6.5	-10.0	-17.8					
706	0.31	1.1	6.00	0.79	0.76	0.75	0.0129	-0.021	60.9	-5.0	-9.7					
707	0.30	1.1	6.00	0.71	0.68	0.69	0.0421	-0.015	16.9	-5.0	-9.5	1.75	20.	0.0	0.	0.16 ROUND
708	0.30	1.1	6.03	0.81	0.76	0.78	0.0096	-0.026	64.6	-5.0	-9.4					
709	0.29	1.1	6.03	0.69	0.66	0.73	0.0734	-0.026	9.3	-5.0	-9.2	1.75	20.	0.0	0.	0.26 ROUND
710	0.60	2.1	2.97	0.59	0.55	0.57	0.0122	-0.020	48.6	-10.0	-27.5					
711	0.59	2.1	2.93	0.41	0.48	0.45	0.0476	-0.029	6.8	-10.0	-26.9	1.40	45.	20.	0.0	0.41 0.50
712	0.60	2.1	2.96	0.60	0.53	0.58	0.0112	-0.020	53.6	-10.0	-27.4					
713	0.54	2.0	2.96						-11.4	-25.9	1.40	45.	20.	5.0	9.	0.44 0.47
714	0.59	2.1	5.98	0.69	0.68	1.06			-10.0	-27.2						ICE FROM 713
715	0.56	2.0	2.98	0.46	0.53	0.58	-0.025	-0.009	-10.0	-26.1						ICE FROM 713
716	0.59	2.1	-0.04	0.13	0.08	0.07			-10.0	-26.0						ICE FROM 713
717	0.59	2.1	5.99	0.96	0.89	0.86			-10.0	-26.9						
718	0.59	2.1	5.99	0.80	0.93	0.92			-10.0	-26.9						
719	0.59	2.1	2.98	0.60	0.53	0.57			-10.0	-26.6						
720	0.58	2.1	2.97	0.46	0.53	0.55			-10.0	-26.4						
721	0.58	2.1	3.00	0.54	0.31	0.56	0.1460	-0.044	3.9	4.8	-12.7	1.40	20.			NON-UNIFORM ICE
722	0.53	1.0	3.03	0.54	0.31	0.56	0.1241	-0.029	3.9	2.0	-12.2	1.40	120.	20.		ONSET OF ICING
723	0.54	1.0	3.03	0.49	0.35	0.52	0.1241	-0.052	-10.0	-26.9	1.40	45.	20.	0.0	0.	UNKNOWN BEAK
724	0.60	2.1	6.00						-10.0	-26.6	0.85	20.				ONSET OF ICING
725	0.60	2.1	5.93	0.95	0.94	0.87	0.0349	-0.019	27.2	-10.0	-27.2	0.85	45.	20.	0.0	0.41 0.47
726	0.60	2.1	5.94	0.81	0.95	0.91	0.0461	-0.041	17.6	-10.0	-27.2					
727	0.31	1.2	5.89	0.83	0.75	0.75	0.0103	-0.042	80.9	-15.0	-19.5					
728	0.31	1.2	5.89	0.73	0.69	0.72	0.0305	-0.042	23.8	-15.0	-19.5	1.06	45.	20.	0.0	0.16 RIME
729	0.31	1.1	5.91	0.83	0.80	0.75	0.0107	-0.039	77.4	-5.0	-9.5					
730	0.30	1.1	5.90	0.73	0.69	0.61	0.0566	-0.031	12.9	-5.0	-9.3	1.06	45.	20.	0.0	0.16 ROUND
731	0.31	1.1	5.89	0.84	0.77	0.76	0.0102	-0.038	82.4	-6.0	-10.5					
732	0.31	1.1	5.89	0.77	0.69	0.70	0.0245	-0.037	31.3	-6.0	-10.5	0.50	45.	20.	0.0	0.06 ROUND
733	0.31	1.2	5.87	0.86	0.71	0.75	0.0097	-0.060	88.9	-16.0	-20.4					
734	0.31	1.2	5.87	0.74	0.68	0.68	0.0401	-0.062	18.3	-16.0	-20.4					
735	0.39	1.5	-0.06	0.11	0.06	0.07	0.0097	-0.031	10.9	-10.0	-17.7					

APPENDIX A (CONT.)

CONFIGURATION - 21 SC1095 AIRFOIL

CONFIGURATION - 4, VR-7 AIRFOIL

APPENDIX A (CONT)

CONFIGURATION - 4, VR-7 AIRFOIL

RUN	MACH	RN	ALPH	CLP	CLPL	CL40	CDW	CMP	L/D	TOT T	STA T	LWC TIME	DIA FREQ	AMP LENGTH	WIDTH	REMARKS
777	0.39	1.6	5.97	0.99	0.0277				35.7	-10.0	-17.9	0.30	60.	20.	5.0	0.09 ROUND
778	0.39	1.6	6.97	1.24	0.0334				37.2	-10.0	-17.7					ICE FROM 777
779	0.39	1.5	3.03	0.60	0.0173				34.5	-10.0	-17.7					ICE FROM 777
780	0.39	1.5	0.03	0.19	0.0154				12.3	-10.0	-17.6					ICE FROM 777
781	0.68	2.4	0.01	0.22	0.0122				18.4	-10.0	-32.4					
782	0.68	2.4	0.01	0.21	0.0202				10.7	-10.0	-32.6	0.35	45.	20.	0.0	0.19 RIME
783	0.58	2.2	3.03	0.73	0.0100				72.6	-10.0	-26.8					
784	0.58	2.2	2.99	0.68	0.0341				20.1	-10.0	-26.7	0.50	60.	5.0	9.	0.24 0.20
785	0.58	2.2	6.00	1.11	0.0387				26.7	-10.0	-27.0					ICE FROM 784
786	0.58	2.2	0.04	0.20	0.0305				6.6	-10.0	-26.8					ICE FROM 784

CONFIGURATION - 3, SSC-A09 AIRFOIL

RUN	MACH	RN	ALPH	CLP	CLPL	CL40	CDW	CMP	L/D	TOT T	STA T	LWC TIME	DIA FREQ	AMP LENGTH	WIDTH	REMARKS
787	0.28	1.0	-0.03	0.07	0.05	0.14			-0.015			10.0				
788	0.28	1.0	-0.05	-0.03	0.06	0.05	0.0098	0.022	-2.8			10.0				
789	0.31	0.9	-0.06				0.0072		6.9			10.9				NO CP DATA NO DATA
790																
791	0.29	1.0	5.98	0.74	0.77	0.80	0.0134	-0.008	54.9			10.0				
792	0.29	1.0	5.92	0.80	0.75	0.80	0.0129	-0.023	62.1			10.0				
793	0.29	1.0	-0.03	0.09	0.07	0.11	0.0079	-0.005	11.5			10.0				
794	0.29	1.0	-0.03	0.09	0.06	0.11	0.0084	-0.005	11.0			10.0				
795	0.29	1.0	-0.03	-0.15	-0.17	-0.16	0.0102	0.002	-14.9			10.0				
796	0.29	1.0	-0.02	0.08	0.02	0.07	0.0081	-0.004	9.7			10.0				
797	0.29	1.0	3.00	0.43	0.39	0.44	0.0105	-0.012	41.2			10.0				
798	0.29	1.0	5.99	0.78	0.73	0.81	0.0113	-0.018	65.9			10.0				
799	0.29	1.0	9.00	1.10	1.07	1.11	0.0178	-0.024	62.1			10.0				
800	0.29	1.0	12.01	1.31	1.28	1.31	0.0475	-0.040	27.5			10.0				
801	0.29	1.0	13.04	1.27	1.19	1.49	0.1348	-0.102	9.5			10.0				
802	0.29	1.0	14.05	1.33	1.17	1.48	0.1447	-0.110	9.3			10.0				
803	0.30	1.0	15.04	1.35	1.21	1.56	0.1774	-0.126	7.8			10.0				
804	0.29	1.0	-0.03	0.10	0.08	0.07	0.0076	-0.007	12.6			10.0				
805	0.39	1.3	-0.03	0.09	0.09	0.07	0.0091	-0.002	9.6			10.0				
806	0.39	1.3	-2.03	-0.16	-0.15	-0.17	0.0099	0.004	-15.8			10.0				
807	0.39	1.3	-0.03	0.09	0.09	0.07	0.0091	-0.002	9.6			10.0				
808	0.39	1.3	2.99	0.47	0.44	0.47	0.0111	-0.013	42.0			10.0				
809	0.38	1.3	7.51	1.14	1.13	1.15	0.0197	-0.024	57.9			10.0				
810	0.39	1.3	9.02	1.18	1.16	1.15	0.0219	-0.021	53.8			10.0				
811	0.39	1.3	11.02	1.19	1.21	1.41	0.1105	-0.070	10.8			10.0				
812	0.39	1.3	11.54	1.19	1.19	1.46	0.1318	-0.091	9.2			10.0				
813	0.39	1.3	12.06	1.21	1.23	1.55	0.1504	-0.110	8.1			10.0				
814	0.39	1.3	13.05	1.24	1.23	1.60	0.1652	-0.128	7.6			10.0				
815	0.38	1.3	0.01	0.10	0.10	0.09	0.0087	-0.003	11.8			10.0				
816	0.48	1.6	0.0	0.11	0.11	0.11	0.0100	-0.005	11.3			10.0				
817	0.48	1.6	-2.02	-0.16	-0.17	-0.17	0.0113	-0.001	-14.0			10.0				

ONLINE DATA ONLY

CONFIGURATION - 3, SSC-A09 AIRFOIL

APPENDIX A (CONT)

RUN	MACH	RN	ALPH	CLP	CLPL	CL40	CDW	CMP	L/D	TOT T	LMC TIME	DIA FREQ	AMP LENGTH	WIDTH	REMARKS
818	0.48	1.6	0.01	0.10	0.09	0.09	0.0100	-0.004	10.3	10.0	-2.7				
819	0.48	1.6	2.95	0.50	0.46	0.49	0.0117	-0.014	42.6	10.0	-2.7				
820	0.49	1.6	6.00	0.91	0.87	0.90	0.0140	-0.020	64.7	10.0	-2.7				
821	0.49	1.6	8.98	1.18	1.15	1.12	0.0405	-0.009	29.1	10.0	-2.8				
822	0.49	1.6	10.02	1.20	1.18	1.17	0.0627	-0.022	19.2	10.0	-2.8				
823	0.49	1.6	11.04	1.24	1.15	1.44	0.1099	-0.075	11.3	10.0	-2.8				
824	0.49	1.6	12.09	1.24	1.18	1.48	0.1349	-0.108	9.3	10.0	-3.0				
825	0.48	1.6	0.01	0.12	0.11	0.10	0.0085	-0.005	13.8	10.0	-2.6				
826	0.58	1.9	-0.07	0.10	0.09	0.10	0.0099	-0.006	10.1	10.0	-7.7				
827	0.58	1.9	-1.95	-0.19	-0.20	-0.21	0.0105	0.003	-16.4	10.0	-6.0				
828	0.58	1.9	0.02	0.11	0.11	0.10	0.0091	-0.007	11.8	10.0	-7.9				
829	0.58	1.9	2.97	0.51	0.50	0.53	0.0103	-0.017	49.5	10.0	-7.9				
830	0.58	1.9	5.94	0.95	0.93	0.92	0.0310	-0.017	30.6	10.0	-7.6				
831	0.58	1.9	8.89	1.20	1.18	1.24	0.0732	-0.035	16.5	10.0	-7.7				
832	0.59	1.9	9.94	1.24	1.21	1.38	0.0844	-0.058	14.8	10.0	-8.1				
833	0.58	1.9	-0.06	0.12	0.11	0.12	0.0089	-0.007	13.0	10.0	-7.8				
834	0.68	2.1	0.00	0.13	0.11	0.13	0.0109	-0.009	12.0	10.0	-13.7				
835	0.67	2.1	-2.04	-0.19	-0.19	-0.19	0.0113	-0.003	-16.4	10.0	-13.3				
836	0.69	2.1	0.00	0.13	0.12	0.13	0.0108	-0.008	11.9	10.0	-14.7				
837	0.68	2.1	-1.96	0.45	0.45	0.49	0.0158	-0.019	28.5	10.0	-13.9				
838	0.67	2.1	3.96	0.75	0.77	0.66	0.0318	-0.025	23.6	10.0	-13.4				
839	0.68	2.1	-0.06	0.12	0.11	0.13	0.0107	-0.008	11.5	10.0	-13.6				
840	0.72	2.2	-0.06	0.13	0.12	0.14	0.0117	-0.010	11.5	10.0	-16.3				
841	0.75	2.2	-0.06	0.14	0.13	0.15	0.0129	-0.012	10.6	10.0	-18.2				
842	0.77	2.2	-0.07	0.14	0.13	0.16	0.0168	-0.016	6.4	10.0	-19.7				
843	0.30	1.0	8.91	1.14	1.10	1.14	0.0169	-0.028	67.3	10.0	5.3				
844	0.30	1.0	9.92	1.17	1.16	1.15	0.0244	-0.023	48.0	10.0	5.3				
845	0.30	1.0	10.88	1.26	1.21	1.22	0.0264	-0.025	47.7	10.0	5.3				
846	0.30	1.0	11.90	1.26	1.27	1.38	0.0764	-0.072	16.4	10.0	5.4				
847	0.30	1.0	12.37	1.23	1.27	1.52	0.1384	-0.097	9.0	10.0	5.4				
848	0.39	1.3	2.93	0.48	0.44	0.48	0.0094	-0.017	51.1	10.0	1.6				
849	0.39	1.3	5.91	0.84	0.81	0.85	0.0112	-0.022	75.0	10.0	1.7				
850	0.40	1.3	6.94	1.17	1.15	1.16	0.0197	-0.021	59.6	10.0	1.7				
851	0.39	1.3	9.89	1.24	1.23	1.20	0.0285	-0.019	43.4	10.0	1.8				
852	0.40	1.3	10.39	1.22	1.26	1.28	0.0748	-0.037	16.3	10.0	1.7				
853	0.29	1.0	6.00												
854	0.29	1.0	0.00												
855	0.58	2.0	6.00												
856	0.58	2.0	6.00												
857	0.58	2.0	6.23	0.97	0.96	0.96	0.0271	-0.019	36.0	10.0	-26.3				
858	0.58	2.1	6.22	0.98	0.96	0.94	0.0290	-0.021	33.6	10.0	-26.6				
859	0.59	2.1	6.22	0.95	0.95	0.91	0.0341	-0.026	26.8	10.0	-26.4				
860	0.58	2.0	0.01	0.09	0.09	0.10	0.0995	-0.007	9.9	10.0	-26.4				
861	0.59	2.1	0.01	0.08	0.06	0.11	0.0340	-0.010	2.4	10.0	-26.8				
862	0.58	2.1	-0.01	0.06	0.05	0.07	0.0097	-0.004	6.2	10.0	-26.6				
863	0.58	2.0	0.03	0.07	0.06	0.07	0.0207	-0.006	3.4	10.0	-26.1				
864	0.58	2.1	3.04	0.46	0.51	0.50	0.0207	-0.021	22.1	10.0	-26.6				

ICE FROM 863

ONSET OF ICING
ONSET OF ICING
ONSET OF ICING

APPENDIX A (CONT)

CONFIGURATION - 3, SSC-A09 AIRFOIL

RUN	MACH	RN	ALPH	CLPH	CLP	CLPL	CL40	CDW	CMP	L/D	TOT T	STA T	LNC TIME	DIA FREQ	AMP LENGTH	WIDTH	REMARKS	
865	0.55	2.0	6.01	0.79	0.89	0.85	0.0350	-0.026	22.5	-10.0	-25.0					ICE FROM 863		
856	0.59	2.1	6.02	0.79	0.92	0.87	0.0346	-0.029	22.8	-10.0	-27.1					ICE FROM 863		
867	0.60	2.1	-0.01	0.07	0.05	0.05	0.0105	-0.005	6.4	-10.0	-27.4					ICE FROM 868		
868	0.58	2.0	0.01	0.05	0.04	0.13		-0.013		-10.0	-26.2	0.50	60.	20.	0.	0.27	0.25	
869	0.58	2.1	0.02	0.06	0.05	0.10	0.0404	-0.011	1.6	-10.0	-26.6					ICE FROM 868		
870	0.58	2.1	3.10	0.53	0.50	0.54	0.0107	-0.018	49.6	-10.0	-26.7					ICE FROM 873		
871	0.59	2.1	2.99	0.45	0.50	0.53	0.0274	-0.023	16.4	-10.0	-26.9	0.50	45.	20.	0.	0.16	0.25	
872	0.59	2.1	2.99	0.51	0.49	0.51	0.0103	-0.017	49.4	-10.0	-26.9					ICE FROM 873		
873	0.59	2.1	3.02	0.48	0.50	0.57	0.0246	-0.021	19.6	-10.0	-26.8	0.50	45.	20.	5.0	9.	0.16	0.13
874	0.62	2.1	-0.04	0.08	0.04	0.10	0.0236	-0.011	3.4	-10.0	-28.5					ICE FROM 873		
875	0.58	2.1	6.05	0.82	0.94	0.90	0.0281	-0.029	29.2	-10.0	-26.8					ICE FROM 873		
876	0.58	2.1	9.02	1.06	1.23	1.11	0.0477	-0.033	22.2	-10.0	-26.7					ICE FROM 873		
877	0.49	1.8	5.93	0.89	0.86	0.91	0.0136	-0.021	65.5	-10.0	-22.3	0.53	60.	20.	0.	0.19	0.16	
878	0.49	1.8	5.92	0.77	0.84	0.85	0.0286	-0.035	26.9	-10.0	-22.3	0.53	60.	20.	0.	0.19	0.16	
879	0.38	1.5	5.90	0.83	0.78	0.84	0.0123	-0.024	67.8	-10.0	-17.6					ICE FROM 860		
880	0.38	1.5	5.90	0.70	0.76	0.77	0.0439	-0.019	16.0	-10.0	-17.5	0.62	60.	20.	0.	0.16	0.16	
881	0.39	1.5	8.92	0.94	1.00	1.05	0.0950	-0.043	9.9	-10.0	-17.9					ICE FROM 860		
882	0.38	1.5	2.97	0.43	0.42	0.48	0.0247	-0.022	17.6	-10.0	-17.6					ICE FROM 860		
883	0.38	1.5	5.94	0.83	0.80	0.87	0.0124	-0.023	67.0	-10.0	-17.7					ICE FROM 864		
884	0.38	1.5	5.92	0.70	0.76	0.79	0.0372	-0.024	18.8	-10.0	-17.6	0.62	60.	20.	0.	0.16	0.16	
885	0.39	1.5	8.95	0.94	1.04	1.00	0.0821	-0.034	11.5	-10.0	-17.9					ICE FROM 864		
886	0.39	1.5	2.95	0.42	0.42	0.45	0.0213	-0.021	19.6	-10.0	-17.6					ICE FROM 884		
887	0.38	1.5	5.91	0.81	0.79	0.83	0.0125	-0.023	65.4	-10.0	-17.8	0.62	20.	20.	0.	0.03	ROUND	
888	0.38	1.5	5.91	0.77	0.77	0.75	0.0286	-0.024	26.9	-10.0	-17.8	0.62	20.	20.	0.	0.03	ROUND	
889	0.39	1.5	5.99	0.83	0.79	0.84	0.0126	-0.022	65.9	-10.0	-17.9					ICE FROM 890		
890	0.39	1.5	5.92	0.76	0.78	0.83	0.0287	-0.026	26.4	-10.0	-17.9	0.30	60.	20.	0.	0.09	ROUND	
891	0.38	1.5	8.92	1.03	1.10	1.08	0.0375	-0.026	27.4	-10.0	-17.8					ICE FROM 890		
892	0.38	1.5	2.98	0.44	0.43	0.45	0.0176	-0.018	25.2	-10.0	-17.6					ICE FROM 890		
893	0.38	1.5	5.93	0.81	0.79	0.81	0.0124	-0.021	65.6	-10.0	-17.8	0.30	60.	20.	0.	0.09	ROUND	
894	0.39	1.5	5.94	0.77	0.77	0.76	0.0254	-0.027	30.4	-10.0	-17.8	0.30	60.	20.	5.0	9.	0.09	ROUND
895	0.39	1.5	8.92	1.05	1.10	1.09	0.0310	-0.028	33.8	-10.0	-17.8					ICE FROM 894		
896	0.38	1.5	2.95	0.44	0.42	0.46	0.0156	-0.017	28.3	-10.0	-17.6					ICE FROM 894		
897	0.67	2.3	0.02	0.10	0.08	0.10	0.0118	-0.007	8.2	-10.0	-32.2					ICE FROM 894		
898	0.66	2.2	0.03	0.10	0.08	0.11	0.0328	-0.010	3.0	-10.0	-31.5	0.35	45.	20.	0.	0.09	0.25	
899	0.40	1.5	9.02	1.14	1.12	1.12	0.0182	-0.026	62.6	-10.0	-17.9					ICE FROM 894		
900	0.40	1.5	9.01	0.94	1.01	1.01	0.0496	-0.029	19.0	-10.0	-17.9	0.62	60.	20.	0.	0.	0.19	ROUND
901	0.30	1.1	9.00	1.09	1.06	1.08	0.0157	-0.027	69.1	-10.0	-14.4					ICE FROM 894		
902	0.30	1.1	8.99	0.92	0.97	0.94	0.0570	-0.031	16.2	-10.0	-14.3	0.66	60.	20.	0.	0.	0.19	ROUND
903	0.30	1.1	8.98	1.11	1.05	1.10	0.0160	-0.027	69.1	-10.0	-14.3					ICE FROM 894		
904	0.29	1.1	6.01	0.77	0.74	0.77	0.0106	-0.021	72.9	-10.0	-14.3					ICE FROM 894		
905	0.29	1.1	6.00	0.68	0.68	0.74	0.0334	-0.026	20.4	-10.0	-14.3	0.66	60.	20.	0.	0.	0.19	ROUND
906	0.30	1.1	5.99	0.77	0.71	0.76	0.0108	-0.023	71.5	-10.0	-14.5					ICE FROM 894		
907	0.30	1.2	5.99	0.73	0.68	0.73	0.0244	-0.025	29.8	-10.0	-14.5	0.35	60.	20.	0.	0.	0.09	ROUND
908	0.30	1.1	3.00	0.41	0.39	0.37	0.0085	-0.012	48.3	-10.0	-14.5					ICE FROM 894		
909	0.30	1.1	3.00	0.40	0.32	0.40	0.0241	-0.017	16.5	-10.0	-14.4	0.66	60.	20.	0.	0.	0.09	ROUND
910	0.30	1.1	3.00	0.40	0.38	0.40	0.0094	-0.009	48.2	-10.0	-14.4					ICE FROM 894		
911	0.30	1.1	2.99	0.40	0.37	0.40	0.0230	-0.019	17.5	-10.0	-14.4	0.66	60.	20.	5.0	9.	0.13	ROUND

CONFIGURATION - 3, SSC-A09 AIRFOIL

RUN	MACH	RN	ALPH	CLP	CLPL	CL40	CDW	CMP	L/D	TOT T	STA T	LWC TIME	DIA FREQ AMP	LNGTH WIDTH	REMARKS
912	0.30	1.1	6.00	0.70	0.68	0.73	0.0269	-0.023	25.9	-10.0	-14.3				ICE FROM 911 ICE FROM 911
913	0.29	1.1	0.01	0.08	0.06	0.05	0.0160	-0.004	4.9	-10.0	-14.2				ICE FROM 911 ICE FROM 911
914	0.30	1.1	0.01	0.06	0.06	0.05	0.0073	-0.002	7.9	-10.0	-14.3				
915	0.30	1.1	0.0	0.06	0.05	0.04	0.0211	-0.006	3.0	-10.0	-14.3	0.66	60.	20.	0.0 0. 0.13 ROUND
916	0.30	1.1	6.01	0.79	0.74	0.79	0.0105	-0.025	75.2	-10.0	-14.4				
917	0.30	1.1	5.99	0.71	0.72	0.76	0.0263	-0.026	27.2	-10.0	-14.4	0.66	60.	20.	5.0 9. 0.13 ROUND
918	0.30	1.1	8.99	0.95	1.02	0.94	0.0378	-0.022	25.2	-10.0	-14.3				
919	0.29	1.1	3.01	0.41	0.39	0.43	0.0173	-0.019	24.0	-10.0	-14.3				
920	0.29	1.1	6.03	0.77	0.75	0.77	0.0109	-0.020	70.6	-10.0	-14.3				
921	0.29	1.1	6.03	0.67	0.68	0.69	0.0419	-0.017	15.9	-10.0	-14.2	1.06	60.	20.	0.0 0. 0.22 0.31
922	0.29	1.1	6.05	0.79	0.75	0.82	0.0118	-0.019	66.7	-10.0	-14.3				
923	0.27	1.1	6.03	0.68	0.70	0.97	0.1203	-0.045	5.6	-10.0	-13.8	1.75	60.	20.	0.0 0. 0.19 0.38
924	0.59	2.1	6.05	0.96	0.96	0.92	0.0270	-0.018	35.6	-10.0	-27.0				
925															ICE SHED, NO DATA
926	0.58	2.1	6.03	0.96	0.95	0.92	0.0254	-0.019	37.9	-10.0	-26.6				
927	0.59	2.1	6.03	0.81	0.95	0.97	0.0384	-0.037	21.2	-10.0	-27.0	0.85	30.	20.	0.0 0. 0.28 0.25
928	0.59	2.1	6.04	0.95	0.96	0.92	0.0271	-0.020	35.2	-10.0	-27.0				
929	0.58	2.1	6.04	0.86	0.86	0.96	0.0371	-0.039	23.2	-10.0	-26.8	1.40	30.	20.	0.0 0. 0.31 0.22
930	0.58	2.1	6.04	0.97	0.96	0.94	0.0280	-0.019	34.8	-10.0	-26.5				
931	0.59	2.1	6.03	0.79	0.94	0.88	0.0547	-0.040	14.4	-10.0	-27.0	0.85	45.	20.	0.0 0. 0.27 0.38

CONFIGURATION - 4, VR-7 AIRFOIL

RUN	MACH	RN	ALPH	CLP	CLPL	CL40	CDW	CMP	L/D	TOT T	STA T	LWC TIME	DIA FREQ AMP	LNGTH WIDTH	REMARKS
932															NO DATA
933	0.29	1.1	5.95												ONSET OF ICING
934	0.58	2.2	5.95												ONSET OF ICING
935	0.58	2.2	3.00	0.81			0.0109		74.3	-10.0	-26.8	0.50	20.		
936	0.59	2.2	3.00	0.79			0.0382		20.5	-10.0	-27.0	0.50	60.	20.	0.0 0. 0.25 0.23

937 TO 944

TUNNEL SPEED - POWER DETERMINATION

CONFIGURATION - 6, SC1012 R8 AIRFOIL

RUN	MACH	RN	ALPH	CLP	CLPL	CL40	CDW	CMP	L/D	TOT T	STA T	LWC TIME	DIA FREQ AMP	LNGTH WIDTH	REMARKS
945	0.29	1.0	-0.01	0.07	0.01	0.12	0.0129	-0.030	5.4	10.0					5.4
946	0.29	1.0	-2.03	-0.17	-0.17	-0.09	0.0149	-0.032	-11.2	10.0					5.4
947	0.28	1.0	0.0	0.02	0.06	0.09	0.0127	-0.033	1.9	10.0					5.6
948	0.29	1.0	3.02	0.44	0.39	0.50	0.0123	-0.031	35.8	10.0					5.5
949	0.29	1.0	6.03	0.82	0.81	0.85	0.0136	-0.040	59.9	10.0					5.3
950	0.29	1.0	9.04	1.18	1.07	1.21	0.0183	-0.035	64.5	10.0					5.3
951	0.29	1.0	12.05	1.40	1.41	1.57	0.0254	-0.022	55.2	10.0					5.3

APPENDIX A (CONT)

CONFIGURATION - 6, SC1012 R8 AIRFOIL

RUN	MACH	RN	ALPH	CLP	CLPL	CL40	CDW	CMP	L/D	TOT T	STA T	LNC TIME	DIA FREQ	AMP	LNTH	WIDTH	REMARKS
952	0.29	1.0	13.08	1.51	1.47	1.47	0.0310	-0.023	51.5	10.0	10.0	5.3					
953	0.29	1.0	14.08	1.59	1.58	1.47	0.0331	-0.020	48.0	10.0	10.0	5.4					
954	0.30	1.0	15.07	1.63	1.65	1.48	0.0413	-0.020	41.0	10.0	10.0	5.2					
955	0.29	1.0	16.06	1.66	1.67	1.42	0.0618	-0.028	29.0	10.0	10.0	5.2					
956	0.29	1.0	16.57	1.59	1.63	1.22	0.0849	-0.039	19.8	10.0	10.0	5.2					
957	0.32	1.0	17.08	1.19	1.20	1.47	0.1462	-0.212	8.1	11.0	11.0	5.1					
958	0.29	1.0	18.10	1.28	1.24	1.50	0.1891	-0.213	6.8	10.0	10.0	5.3					
959	0.39	1.3	-0.06	0.08	0.05	0.13	0.0123	-0.032	6.4	10.0	10.0	1.8					
960	0.39	1.4	-2.01	-0.16	-0.21	-0.10	0.0142	-0.030	-11.3	10.0	10.0	1.6					
961	0.39	1.4	0.0	0.07	0.05	0.12	0.0121	-0.029	5.9	10.0	10.0	1.7					
962	0.39	1.3	3.00	0.47	0.44	0.52	0.0111	-0.035	42.0	10.0	10.0	1.7					
963	0.39	1.4	6.02	0.65	0.61	0.89	0.0130	-0.036	65.6	10.0	10.0	1.7					
964	0.39	1.4	9.06	1.19	1.17	1.20	0.0184	-0.033	64.6	10.0	10.0	1.6					
965	0.39	1.4	12.03	1.38	1.38	1.31	0.0355	-0.020	38.7	10.0	10.0	1.6					
966	0.39	1.4	13.05	1.40	1.40	1.27	0.0457	-0.021	31.4	10.0	10.0	1.7					
967	0.39	1.4	14.03	1.40	1.41	1.16	0.0511	-0.034	28.1	10.0	10.0	1.6					
968	0.39	1.4	15.06	1.17	1.11	1.53	0.3020	-0.198	3.9	10.0	10.0	1.6					
969	0.27	1.5	-0.01	0.09	0.05	0.16	-0.034	-0.034	10.0	10.0	10.0	-5.4					
970	0.27	1.5	0.01	0.07	0.03	0.14	-0.034	-0.034	10.0	10.0	10.0	-5.7					
971	0.48	1.6	0.01	0.08	0.05	0.14	0.0129	-0.035	6.5	10.0	10.0	-2.5					
972	0.48	1.6	-2.02	-0.16	-0.20	-0.06	0.0296	-0.035	-5.4	10.0	10.0	-2.7					
973	0.48	1.6	0.0	0.07	0.05	0.12	0.0130	-0.033	5.2	10.0	10.0	-2.4					
974	0.48	1.6	3.02	0.50	0.47	0.54	0.0130	-0.036	36.1	10.0	10.0	-2.6					
975	0.49	1.7	6.03	0.88	0.85	0.90	0.0180	-0.035	49.0	10.0	10.0	-2.9					
976	0.49	1.6	9.02	1.15	1.15	1.12	0.0429	-0.024	26.9	10.0	10.0	-2.8					
977	0.48	1.6	10.02	1.19	1.18	1.13	0.0627	-0.027	19.0	10.0	10.0	-2.8					
978	0.48	1.6	11.06	1.17	1.16	1.23	0.1782	-0.064	6.6	10.0	10.0	-2.7					
979	0.48	1.6	11.05	1.16	1.16	1.32	0.1484	-0.113	8.0	10.0	10.0	-2.7					
980	0.48	1.7	12.06	1.12	1.03	1.37	0.1413	-0.151	8.0	10.0	10.0	-2.6					
981	0.48	1.6	0.0	0.08	0.05	0.11	0.0126	-0.035	6.1	10.0	10.0	-2.5					
982	0.58	1.9	0.0	0.09	0.05	0.15	0.0152	-0.037	5.7	10.0	10.0	-8.0					
983	0.58	1.9	-2.02	-0.17	-0.21	-0.07	0.0344	-0.040	-4.9	10.0	10.0	-8.1					
984	0.58	1.9	-0.02	0.07	0.04	0.12	0.0152	-0.035	4.7	10.0	10.0	-8.0					
985	0.58	1.9	3.00	0.53	0.51	0.60	0.0156	-0.038	34.2	10.0	10.0	-8.0					
986	0.58	1.9	6.02	0.93	0.91	0.91	0.0425	-0.037	21.8	10.0	10.0	-7.9					
987	0.58	1.9	9.03	1.06	0.99	1.23	0.0859	-0.067	12.4	10.0	10.0	-8.4					
988	0.57	1.9	0.0	0.08	0.04	0.13	0.0152	-0.035	5.1	10.0	10.0	-7.4					
989	0.68	2.1	0.01	0.09	0.05	0.18	0.0208	-0.043	4.3	10.0	10.0	-14.1					
990	0.68	2.1	-1.01	-0.05	-0.10	0.05	0.0282	-0.044	-1.8	10.0	10.0	-14.0					
991	0.68	2.1	-0.02	0.06	0.05	0.18	0.0202	-0.043	4.1	10.0	10.0	-14.0					
992	0.68	2.1	1.99	0.38	0.34	0.44	0.0240	-0.043	16.0	10.0	10.0	-14.0					
993	0.68	2.1	-0.01	0.09	0.05	0.17	0.0211	-0.043	4.1	10.0	10.0	-14.0					
994	0.71	2.2	0.0	0.08	0.04	0.18	0.0304	-0.048	2.7	10.0	10.0	-16.5					
995	0.73	2.2	-0.02	0.06	0.04	0.17	0.0337	-0.051	2.3	10.0	10.0	-17.6					

ONLINE DATA ONLY

CONFIGURATION - 6, SC1012 R8 AIRFOIL

APPENDIX A (CONT)

RUN	MACH	RN	ALPH	CLP	CLPL	CL40	CDW	CMP	L/D	TOT T	STA T	LWC TIME	DIA FREQ	AMP LNGTH	WIDTH	REMARKS
1003	0.29	1.1	6.00							1.2	-3.3	0.66	20.			ONSET OF ICING ONSET OF ICING NO DATA
1004	0.58	1.9	6.00							7.5	-10.2	0.58	20.			
1005																
1006	0.30	1.2	5.94	0.82	0.79	0.86	0.0129	-0.029	63.6	-10.0	-14.5					
1007	0.29	1.1	5.96	0.87	0.81	0.89	0.0135	-0.042	64.3	-10.0	-14.2					
1008	0.39	1.5	6.00	0.92	0.86	0.95	0.0139	-0.039	66.2	-10.0	-17.6					
1009	0.39	1.5	5.98	0.61	0.74	0.78	0.0727	-0.045	6.4	-10.0	-17.5	1.14	60.	20.	0.0	0.44
1010	0.39	1.5	5.99	0.92	0.87	0.95	0.0138	-0.040	66.7	-10.0	-17.6					0.56
1011	0.38	1.4	5.99	0.55	0.61	0.75	0.1327	-0.072	4.2	-10.0	-17.1	1.75	60.	20.	0.0	0.53
1012	0.39	1.5	6.00	0.90	0.86	0.94	0.0130	-0.035	69.5	-10.0	-17.8					0.25
1013	0.39	1.5	6.00	0.73	0.75	0.86	0.0401	-0.034	16.1	-10.0	-17.6	0.62	60.	20.	0.0	0.22
1014	0.40	1.5	9.02	0.88	0.93	0.89	0.0595	-0.042	14.8	-10.0	-17.8					0.13
1015	0.39	1.5	3.01	0.50	0.48	0.56	0.0287	-0.037	17.3	-10.0	-17.5					
1016	0.39	1.5	-0.02	0.16	0.09	0.28	0.0378	-0.038	4.7	-10.0	-17.6					
1017	0.39	1.5	5.99	0.91	0.86	0.94	0.0132	-0.037	68.7	-10.0	-17.5					
1018	0.39	1.5	6.01	0.73	0.77	0.83	0.0362	-0.035	20.2	-10.0	-17.4	0.62	60.	20.	5.0	9.
1019	0.40	1.5	9.02	0.89	0.92	0.92	0.0616	-0.056	14.7	-10.0	-18.0					
1020	0.39	1.5	3.00	0.51	0.44	0.56	0.0222	-0.031	22.8	-10.0	-17.5					
1021	0.39	1.5	-0.01	0.20	0.10	0.21	0.0235	-0.022	6.6	-10.0	-17.6					
1022	0.39	1.5	6.01	0.92	0.84	0.95	0.0132	-0.038	69.3	-10.0	-17.6					
1023	0.39	1.5	6.00	0.82	0.81	0.92	0.0306	-0.037	26.8	-10.0	-17.7	0.30	60.	20.	0.0	0.09
1024	0.39	1.5	9.03	1.12	1.15	1.16	0.0334	-0.038	33.6	-10.0	-17.5					
1025	0.39	1.5	3.01	0.53	0.49	0.58	0.0177	-0.035	30.1	-10.0	-17.8					
1026	0.39	1.5	-0.01	0.21	0.06	0.21	0.0165	-0.023	12.6	-10.0	-17.6					
1027	0.40	1.5	6.01	0.91	0.86	0.94	0.0137	-0.038	66.3	-10.0	-17.8					
1028	0.40	1.5	6.01	0.81	0.81	0.88	0.0274	-0.040	29.7	-10.0	-17.9	0.30	60.	20.	5.0	9.
1029	0.39	1.5	9.03	1.07	1.10	1.11	0.0325	-0.038	32.8	-10.0	-17.6					
1030	0.39	1.5	3.00	0.54	0.49	0.58	0.0175	-0.032	30.9	-10.0	-17.4					
1031	0.39	1.5	-0.01	0.21	0.09	0.21	0.0162	-0.025	13.0	-10.0	-17.4					
1032	0.39	1.5	9.03	1.24	1.20	1.25	0.0181	-0.038	68.5	-10.0	-17.6					
1033	0.38	1.5	9.03	0.86	0.87	0.93	0.0917	-0.069	9.4	-10.0	-17.3	0.62	60.	20.	0.0	0.19
1034	0.30	1.1	9.02	1.13	1.09	1.16	0.0155	-0.037	73.2	-10.0	-14.4					
1035	0.30	1.1	9.02	0.82	0.83	0.86	0.0826	-0.050	9.9	-10.0	-14.3	0.66	60.	20.	0.0	0.13
1036	0.30	1.1	6.01	0.82	0.77	0.85	0.0128	-0.037	64.1	-10.0	-14.3					
1037	0.30	1.1	5.99	0.69	0.68	0.76	0.0347	-0.031	19.9	-10.0	-14.3	0.66	60.	20.	0.0	0.16
1038	0.30	1.1	3.00	0.49	0.40	0.49	0.0107	-0.028	45.8	-10.0	-14.2					
1039	0.30	1.1	3.00	0.43	0.37	0.47	0.0274	-0.028	15.6	-10.0	-14.3	0.66	60.	20.	0.0	0.17
1040	0.30	1.1	0.0	0.16	0.06	0.12	0.0112	-0.013	14.2	-10.0	-14.4					
1041	0.30	1.1	0.0	0.12	0.03	0.16	0.0295	-0.019	4.2	-10.0	-14.3	0.66	60.	20.	0.0	0.13
1042	0.30	1.1	-0.01	0.15	0.05	0.10	0.0107	-0.013	13.8	-10.0	-14.4					
1043	0.30	1.1	-0.02	0.11	0.04	0.15	0.0250	-0.024	4.2	-10.0	-14.4	0.35	60.	20.	0.0	0.05
1044	0.49	1.8	6.03	0.90	0.85	0.93	0.0151	-0.038	59.9	-10.0	-21.9					
1045	0.51	1.8	6.02	0.72	0.82	0.85	0.0390	-0.044	0.7	-9.1	-22.2	0.72	45.	20.	0.0	0.34
1046	0.49	1.8	6.00	0.89	0.92	0.92	0.0142	-0.039	62.7	-10.0	-22.0					
1047	0.49	1.8	5.99	0.89	0.84	0.92	0.0149	-0.038	60.0	-10.0	-21.8					
1048	0.48	1.8	5.99	0.66	0.76	0.87	0.0473	-0.048	14.0	-10.0	-21.5	0.72	60.	20.	0.0	0.31
1049	0.59	2.1	10.95	0.94	0.94	0.89	-0.031	-0.031	-10.0	-27.3						

ONLINE DATA ONLY
ONLINE DATA ONLY

APPENDIX A (CONT)

CONFIGURATION - 6, SC1012 R8 AIRFOIL

RUN	MACH	RN	ALPH	CLP	CLPL	CL40	CDW	CMP	L/D	TOT T	STA T	LAC TIME	DIA FREQ	AMP	LNGTH	WIDTH	REMARKS		
1050	0.59	2.1	6.02	0.94	0.94	0.89		-0.034	-10.0	-27.4									
1051	0.59	2.1	6.00	0.83	0.92	0.99		-0.055	-10.0	-27.3	0.58	45.	20.	0.0	0.	0.34	0.44		
1052	0.58	2.1	6.00	0.95	0.95	0.90		-0.036	-10.0	-26.9									
1053	0.58	2.1	6.00	0.96	0.96	0.92	0.0368	-0.038	26.1	-10.0	-26.7								
1054	0.59	2.1	6.00	0.80	0.88	0.97	0.0467	-0.050	17.3	-10.0	-27.3	0.58	45.	20.	5.0	9.	0.19	0.34	
1055	0.59	2.1	9.01	0.99	1.06	1.10	0.0622	-0.061	16.0	-10.0	-27.3								
1056	0.58	2.1	3.00	0.50	0.51	0.71	0.0426	-0.053	11.8	-10.0	-26.5								
1057	0.58	2.1	0.0	0.10	0.04	0.16	0.0568	-0.046	1.7	-10.0	-26.6								
1058	0.59	2.1	6.01	0.96	0.96	0.91	0.0385	-0.038	24.9	-10.0	-26.9								
1059	0.59	2.1	6.01	0.90	0.95	0.95	0.0466	-0.041	19.3	-10.0	-27.3	0.35	45.	20.	0.0	0.	0.09	0.34	
1060	0.60	2.1	6.01	0.96	0.96	0.90	0.0428	-0.038	22.5	-10.0	-27.5								
1061	0.60	2.1	5.99	0.92	0.96	0.98	0.0556	-0.042	20.2	-10.0	-27.6	0.35	45.	20.	5.0	9.	0.17	RIME	
1062	0.59	2.1	9.01	1.05	1.07	1.20	0.0782	-0.067	13.6	-10.0	-27.0								
1063	0.58	2.1	3.00	0.56	0.54	0.62	0.0205	-0.039	27.4	-10.0	-26.7								
1064	0.59	2.1	0.0	0.17	0.09	0.24	0.0278	-0.036	6.0	-10.0	-26.7								
1065	0.59	2.1	6.01	0.95	0.94	0.89	0.0376	-0.036	25.3	-10.0	-27.0								
1066	0.59	2.1	6.00	0.91	0.95	0.97	0.0419	-0.043	21.6	-10.0	-27.1	0.58	20.	20.	0.0	0.	0.19	0.28	
1067	0.59	2.1	6.00	0.96	0.95	0.90	0.0397	-0.037	24.3	-10.0	-27.1								
1068	0.60	2.1	5.99	0.83	0.93	1.02	0.0519	-0.052	16.0	-10.0	-27.4	0.58	60.	20.	0.0	0.	0.34	0.38	
1069	0.59	2.1	6.00	0.95	0.96	0.90	0.0398	-0.035	24.0	-10.0	-27.1								
1070	0.60	2.1	6.00	0.65	0.69	0.86	0.0696	-0.060	9.4	-10.0	-27.3	1.12	45.	20.	0.0	0.	0.44	0.63	
1071	0.59	2.1	6.00	0.95	0.96	0.89	0.0389	-0.035	24.5	-10.0	-27.1								
1072	0.58	2.1	6.00	0.60	0.83	0.78	0.0748	-0.058	8.1	-10.0	-26.6	1.31	45.	20.	0.0	0.	0.50	0.59	
1073	0.61	2.1	6.01	0.96	1.05	0.90	0.0423	-0.036	17.9	-8.9	-27.2								
1074	0.59	2.1	6.00	0.69	1.01	0.99	0.0400	-0.069	17.3	-10.0	-27.1	1.40	45.	20.	0.0	0.	0.50	0.59	
1075	0.59	2.1	6.00	0.95	0.96	0.88	0.0396	-0.035	24.1	-10.0	-27.0								
1076	0.59	2.1	6.00	0.64	0.64	0.89	0.0385	-0.0562	-0.068	11.5	-10.0	-27.3	1.40	45.	20.	0.0	0.	0.50	0.59
1077	0.58	2.1	3.00	0.53	0.50	0.60	0.0161	-0.033	37.4	-10.0	-26.7								
1078	0.58	2.1	2.98	0.32	0.41	0.24	0.0664	-0.051	4.8	-10.0	-26.7	0.58	45.	20.	0.0	0.	0.38	0.54	
1079	0.59	2.1	3.00	0.54	0.51	0.61	0.0147	-0.040	36.7	-10.0	-27.4								
1080	0.59	2.1	3.00	0.39	0.44	0.65	0.0430	-0.059	9.1	-10.0	-27.4	0.58	45.	20.	0.0	0.	0.38	0.56	
1081	0.58	2.1	-0.02	0.09	0.04	0.16	0.0142	-0.037	6.4	-10.0	-26.8								
1082	0.57	2.0	-0.03	0.01	0.11	0.0699	-0.043	0.2	-10.0	-26.2	0.58	45.	20.	0.0	0.	0.31	0.41		
1083	0.59	2.1	-0.04	0.09	0.05	0.15	0.0145	-0.036	6.2	-10.0	-27.3								
1084	0.57	2.1	-0.04	-0.02	-0.02	-0.02	0.0628	-0.038	-0.3	-10.0	-26.3	0.58	60.	20.	0.0	0.	0.38	0.59	
1085	0.29	1.1	2.99	0.46	0.38	0.51	0.0120	-0.038	38.5	-5.0	-9.4								
1086	0.29	1.1	2.98	0.37	0.27	0.46	0.0332	-0.031	11.0	-5.0	-9.3	0.66	60.	20.	0.0	0.	0.06	ROUND	

CONFIGURATION - 3, SSC-A09 AIRFOIL

RUN	MACH	RN	ALPH	CLP	CLPL	CL40	CDW	CMP	L/D	TOT T	STA T	LAC TIME	DIA FREQ	AMP	LNGTH	WIDTH	REMARKS	
1087	0.61	2.1	0.0	0.04		0.0108			3.7	-10.0	-28.4							
1088	0.57	2.0	-0.01	0.04		0.0443			0.9	-10.0	-26.0	0.58	45.	20.	5.0	9.	0.22	0.30
1089	0.30	1.1	6.01	0.80	0.71	0.84	0.0117	-0.022	68.2	-10.0	-14.4	69.7	-10.0	-14.5				
1090	0.30	1.1	6.00	0.78	0.73	0.80	0.0112	-0.022										

APPENDIX A (CONT)

CONFIGURATION - 3, SSC-A09 AIRFOIL

RUN	MACH	RN	ALPH	CLP	CLPL	CL40	CDW	CMP	L/D	TOT T	STAT	LUC TIME	DIA FREQ	AMP	LENGTH	WIDTH	REMARKS
1091	0.29	1.1	6.00	0.66	0.74	0.80	0.0979	-0.032	6.7	-10.0	-14.3	1.75	60.	20.	0.0	0.28	0.47
1092	0.29	1.1	10.98	1.28	1.23	1.30	0.0254	-0.022	50.5	-10.0	-14.3	0.66	60.	20.	0.0	0.09	RIME
1093	0.30	1.1	11.03	1.07	1.11	1.06	0.0675	-0.024	15.8	-10.0	-14.4	0.66	60.	20.	0.0	0.09	RIME
1094	0.30	1.1	11.02	1.28	1.30	1.26	0.0262	-0.025	48.8	-5.0	-9.4	0.66	60.	20.	0.0	0.09	ROUND
1095	0.30	1.1	11.01	1.08	1.10	1.14	0.1185	-0.057	9.2	-5.0	-9.5	0.66	60.	20.	0.0	0.09	ROUND
1096	0.30	1.1	11.53	1.10	1.17	1.13	0.1115	-0.051	9.8	-5.0	-9.6	0.66	60.	20.	0.0	0.09	ICE FROM 1095
1097	0.30	1.1	6.00	0.73	0.72	0.77	0.0116	-0.029	63.1	-10.0	-14.5	1.28	60.	20.	0.0	0.25	0.38
1098	0.29	1.1	5.99	0.65	0.74	0.57	0.0663	-0.019	9.8	-10.0	-14.3	1.28	60.	20.	0.0	0.25	0.38
1099	0.30	1.1	6.00	0.77	0.76	0.76	0.0118	-0.029	65.2	-10.0	-14.4	0.66	60.	20.	0.0	0.13	0.28
1100	0.30	1.1	6.00	0.66	0.70	0.66	0.0327	-0.029	20.1	-10.0	-14.3	0.66	60.	20.	0.0	0.13	0.28
1101	0.29	1.1	0.0	0.08	0.06	0.08	0.0076	0.003	10.3	-10.0	-14.3	1.75	60.	20.	0.0	0.25	0.44
1102	0.29	1.1	-0.01	0.05	0.04	0.13	0.0623	-0.006	0.8	-10.0	-14.3	1.75	60.	20.	0.0	0.25	0.44
1103	0.29	1.2	0.0	0.08	0.04	0.12	0.0081	-0.001	10.2	-20.0	-24.1	0.66	60.	20.	0.0	0.30	0.19
1104	0.29	1.2	-0.01	0.08	0.01	0.12	0.0348	-0.007	2.4	-20.0	-24.1	1.75	60.	20.	0.0	0.30	0.19
1105	0.58	2.0	0.01	0.10	0.05	0.13	0.0102	-0.001	9.7	-10.0	-26.6	1.40	45.	20.	0.0	0.44	0.53
1106	0.56	2.0	0.0	0.01	0.02	-0.20	0.0907	0.0	0.1	-10.0	-25.6	1.40	45.	20.	0.0	0.44	0.53
1107	0.59	2.1	6.01	0.89	0.92	0.92	0.0261	-0.025	34.2	-10.0	-27.1	0.66	60.	20.	0.0	0.19	ROUND
1108	0.59	2.1	6.00	0.88	0.92	0.89	0.0326	-0.027	27.0	-10.0	-27.3	0.58	30.	20.	0.0	0.19	ROUND
1109	0.59	2.1	5.99	0.92	0.91	0.87	0.0247	-0.020	37.0	-10.0	-27.3	0.58	30.	20.	0.0	0.09	RIME
1110	0.59	2.1	5.99	0.88	0.92	0.88	0.0298	-0.028	29.7	-10.0	-27.4	0.35	30.	20.	0.0	0.09	RIME
1111	0.59	2.1	6.00	0.92	0.92	0.84	0.0244	-0.020	37.5	-10.0	-26.9	0.66	60.	20.	0.0	0.31	0.25
1112	0.59	2.1	6.00	0.78	0.89	0.95	0.0640	-0.030	12.3	-10.0	-27.3	1.31	30.	20.	0.0	0.31	0.25
1113	0.59	2.1	3.00	0.52	0.48	0.49	0.0112	-0.016	46.4	-10.0	-27.2	0.66	60.	20.	0.0	0.29	0.29
1114	0.58	2.0	2.99	0.45	0.48	0.37	0.0366	-0.024	12.2	-10.0	-26.6	0.58	45.	20.	2.5	9.	0.29
1115	0.59	2.1	3.00	0.50	0.47	0.46	0.0103	-0.015	48.2	-10.0	-27.0	0.66	60.	20.	0.0	0.28	0.22
1116	0.59	2.1	3.00	0.41	0.46	0.51	0.0324	-0.031	12.8	-10.0	-27.3	0.58	45.	20.	5.0	5.	0.28
1117	0.59	2.0	3.01	0.51	0.47	0.49	0.0105	-0.016	48.5	0.0	-17.9	0.58	45.	20.	5.0	9.	0.16
1118	0.58	1.9	3.00	0.41	0.46	0.34	0.0627	-0.016	6.6	0.0	-17.0	0.58	45.	20.	5.0	9.	0.31
1119	0.59	2.0	6.03	0.69	0.69	0.82	0.1137	-0.056	6.1	0.0	-16.1	0.66	60.	20.	0.0	0.16	ROUND
1120	0.58	1.9	0.0	0.03	0.02	0.07	0.0346	-0.014	0.9	0.0	-17.1	0.66	60.	20.	0.0	0.16	ROUND
1121	0.68	2.3	0.02	0.08	0.04	0.08	0.0120	-0.005	6.9	-10.0	-32.3	0.66	60.	20.	0.0	0.28	0.41
1122	0.67	2.2	0.02	0.01	0.04	0.14	0.0424	-0.021	0.3	-10.0	-31.4	0.64	45.	20.	5.0	9.	0.28
1123	0.59	2.0	0.01	0.09	0.05	0.10	0.0102	-0.006	9.4	-10.0	-26.6	0.66	60.	20.	0.0	0.16	RIME
1124	0.60	2.1	-0.01	0.10	0.04	0.05	0.0100	-0.010	9.4	-10.0	-27.3	0.66	60.	20.	0.0	0.16	RIME
1125	0.60	2.1	0.0	0.08	0.04	0.07	0.0105	-0.003	7.9	-10.0	-27.1	0.66	60.	20.	0.0	0.16	RIME
1126	0.59	2.0	0.0	0.08	0.04	0.07	0.0105	-0.003	7.7	-10.0	-26.8	0.35	45.	20.	5.0	9.	0.16
1127	0.59	2.0	0.01	0.07	0.04	0.07	0.0216	-0.003	3.4	-10.0	-26.8	0.35	45.	20.	5.0	9.	0.16
1128	0.59	2.0	0.02	0.07	0.02	0.05	0.0107	-0.003	6.9	-10.0	-26.9	0.36	45.	20.	5.0	9.	0.41
1129	0.56	2.0	0.0	0.04	0.01	0.07	0.1124	-0.006	0.4	-10.0	-25.4	1.36	45.	20.	5.0	9.	0.57
1130	0.57	2.1	0.0	-0.03	-0.03	-0.03	0.1047	-0.005	-1.2	-10.8	-27.1	0.66	60.	20.	0.0	0.16	ONLINE DATA ONLY, ICE FROM 1129
1131	0.59	2.1	0.0	0.02	0.01	-0.01	0.1136	-0.008	0.2	-10.0	-27.0	1.31	45.	20.	5.0	9.	UNKNOWN
1132	0.59	2.1	0.0	0.02	0.01	-0.01	0.1136	-0.008	0.2	-10.0	-27.0	1.31	45.	20.	5.0	9.	UNKNOWN

APPENDIX A (CONT)

CONFIGURATION - 7, OH-58 TAIL ROTOR BLADE

RUN	MACH	RN	ALPH	CLP	CLPL	CL40	CDW	CMP	L/D	TOT T	STA T	LWC TIME	DIA FREQ	AMP LENGTH	WIDTH	REMARKS
1133	0.30	1.0	0.02	-0.03	0.0154	-2.2	-10.0	-14.3	-10.0	-14.3	51.	20.	0.0	0.06	0.19	
1134	0.29	1.0	0.02	-0.02	0.0326	-0.5	-10.0	-14.3	-10.0	-14.3	51.	20.	0.0	0.06	0.19	
1135	0.22	0.7	0.0	-0.06	0.0150	-6.1	-10.0	-12.3	-10.0	-12.3						
1136	0.29	1.0	0.0	-0.01	0.0146	-0.5	-10.0	-14.2	-10.0	-14.2	51.	20.	0.0	0.05	ROUND	
1137	0.29	1.0	-0.01	0.00	0.0220	0.1	-10.0	-14.2	-10.0	-14.2	51.	20.	0.0	0.05	ROUND	
1138	0.30	1.0	3.00	-0.26	0.0153	16.8	-10.0	-14.4	-10.0	-14.4	51.	20.	0.0	0.09	0.06	
1139	0.30	1.0	3.00	0.19	0.0291	6.6	-10.0	-14.4	-10.0	-14.4	51.	20.	0.0	0.09	0.06	
1140	0.30	1.0	6.02	0.49	0.0174	27.9	-10.0	-14.3	-10.0	-14.3	51.	20.	0.0	0.06	0.06	
1141	0.29	1.0	6.01	0.46	0.0373	12.3	-10.0	-14.3	-10.0	-14.3	51.	20.	0.0	0.06	0.06	
1142	0.30	1.0	6.00	0.54	0.0179	30.0	-10.0	-14.4	-10.0	-14.4	51.	20.	0.0	0.11	ROUND	
1143	0.30	1.0	5.99	0.57	0.0338	16.9	-10.0	-14.4	-10.0	-14.4	51.	20.	5.0	9.	0.11 ROUND	
1144	0.30	1.0	8.98	0.85	0.0249	33.9	-10.0	-14.4	-10.0	-14.4	51.	20.	0.0	0.13	0.16	
1145	0.29	0.9	8.97	0.72	0.0870	8.3	-10.0	-14.1	-10.0	-14.1	51.	20.	0.0	0.13	0.16	
1146	0.39	1.3	6.01	0.62	0.0173	35.6	-10.0	-17.7	-10.0	-17.7	51.	20.	0.0	0.16	0.44	
1147	0.38	1.2	6.01	0.57	0.0862	6.6	-10.0	-17.1	-10.0	-17.1	51.	20.	0.0	0.16	0.44	
1148	0.40	1.3	6.01	0.66	0.0190	34.9	-10.0	-17.8	-10.0	-17.8	51.	20.	5.0	9.	0.16 0.38	
1149	0.39	1.3	5.99	0.68	0.0463	14.6	-10.0	-17.6	-10.0	-17.6	51.	20.	5.0	9.	0.16 0.38	

CONFIGURATION - 8, NACA 0012 AIRFOIL (NO TAPS)

RUN	MACH	RN	ALPH	CLP	CLPL	CL40	CDW	CMP	L/D	TOT T	STA T	LWC TIME	DIA FREQ	AMP LENGTH	WIDTH	REMARKS
1150	0.59	2.1	3.03	0.42						-10.0	-26.8					
1151	0.59	2.1	3.00	0.43						-10.0	-27.1					
1152	0.59	2.0	2.99	0.41	0.0113	36.2	-10.0	-26.9	-10.0	-26.9	51.	20.	0.0	0.16	0.13	
1153	0.59	2.0	2.98	0.41	0.0354	11.7	-10.0	-26.8	-10.0	-26.8	51.	20.	0.0	0.16	0.13	

CONFIGURATION - 7, OH-58 TAIL ROTOR BLADE

RUN	MACH	RN	ALPH	CLP	CLPL	CL40	CDW	CMP	L/D	TOT T	STA T	LWC TIME	DIA FREQ	AMP LENGTH	WIDTH	REMARKS
1154	0.39	1.3	5.96	0.69	0.0172	40.1	-10.3	-18.0								ONLINE DATA ONLY
1155	0.39	1.3	5.95	0.66	0.0332	19.9	-10.3	-17.9								ONLINE DATA ONLY
1156	0.39	1.3	5.97	0.69	0.0184	37.5	-10.0	-17.8								ONLINE DATA ONLY
1157	0.39	1.3	6.02	0.66	0.0191	34.4	-10.0	-17.6								ONLINE DATA ONLY
1158	0.39	1.3	6.02	0.64	0.0316	20.4	-10.0	-17.7								ONLINE DATA ONLY
1159	0.40	1.3	9.00	0.92	0.0307	30.0	-10.0	-17.8								ONLINE DATA ONLY
1160	0.38	1.2	9.00	0.76	0.1089	7.0	-10.0	-17.3								ONLINE DATA ONLY
1161	0.40	1.3	6.01	0.64	0.0191	33.6	-10.0	-17.8								ONLINE DATA ONLY
1162	0.49	1.6	6.01	0.75	0.0214	35.0	-10.0	-22.1								ONLINE DATA ONLY
1163	0.49	1.6	6.02	0.68	0.0515	13.3	-10.0	-22.1								ONLINE DATA ONLY
1164	0.59	1.8	0.01	-0.03	0.0180	-1.8	-10.0	-26.8								ONLINE DATA ONLY
1165	0.58	1.8	0.02	-0.04	0.0377	-1.1	-10.0	-26.6								ONLINE DATA ONLY
1166	0.56	1.8	-0.03	-0.05	0.0182	-3.8	-12.0	-27.7								ONLINE DATA ONLY
1167	0.58	1.8	0.01	-0.02	0.0674	-0.4	-10.0	-26.5								ONLINE DATA ONLY

APPENDIX A (CONT)

CONFIGURATION - 7, OH-58 TAIL ROTOR BLADE

RUN	MACH	RN	ALPH	CLP	CLPL	CL40	CDW	CMP	L/D	TOT T	STA T	LAC TIME	DIA FREQ	AMP LENGTH	WIDTH	REMARKS
1168	0.59	1.6	3.04	0.41	0.0225					18.1	-10.0	-27.0	0.58	38.	20.	0.0 0. 0.23 0.34
1169	0.59	1.6	3.03	0.38	0.0366					10.4	-10.0	-26.9	0.58	38.	20.	0.0 0. 0.23 0.34
1170	0.59	1.6	3.03	0.40	0.0234					17.0	-5.0	-22.3	0.58	38.	20.	0.0 0. 0.19 0.38
1171	0.58	1.7	3.03	0.38	0.0634					6.0	-5.0	-21.6	0.58	38.	20.	0.0 0. 0.19 0.38
1172	0.59	1.6	3.03	0.42	0.0218					19.4	-10.0	-27.2	0.35	38.	20.	0.0 0. 0.16 0.25
1173	0.60	1.6	3.03	0.40	0.0253					16.0	-10.0	-27.1	0.35	38.	20.	0.0 0. 0.16 0.25
1174	0.59	1.6	6.01	0.75	0.0493					15.2	-5.0	-22.4	0.58	51.	20.	0.0 0. 0.25 0.34
1175	0.58	1.7	6.00	0.59	0.1080					5.5	-5.0	-21.6	0.58	51.	20.	0.0 0. 0.25 0.34
1176	0.59	1.7	6.00	0.75	0.0360					20.9	0.0	-17.6	0.35	51.	20.	0.0 0. 0.14 0.34
1177	0.60	1.7	5.99	0.75	0.0573					13.1	0.0	-17.9	0.35	51.	20.	0.0 0. 0.14 0.34
1178	0.59	1.6	6.00	0.88						-12.0	-27.7	0.35	51.	20.	0.0 0. 0.14 0.34	
1179	0.60	1.6	6.01	0.83						-9.9	-27.6	0.35	51.	20.	0.0 0. 0.14 0.34	
1180	0.59	1.8	6.03	0.76	0.0465					16.3	-10.0	-27.0	0.58	51.	20.	0.0 0. 0.31 0.38
1181	0.60	1.6	6.03	0.79	0.0498					15.9	-10.0	-27.4	0.58	51.	20.	0.0 0. 0.31 0.38
1182	0.59	1.6	6.01	0.70	0.0472					14.9	-10.0	-26.9	0.35	51.	20.	0.0 0. 0.22 0.25
1183	0.60	1.6	6.01	0.69	0.0494					13.9	-10.0	-27.3	0.35	51.	20.	0.0 0. 0.22 0.25
1184	0.30	1.0	0.00	-0.02	0.0140					-1.8	-16.0	-20.1	0.35	51.	20.	0.0 0. 0.08 RIME
1185	0.30	1.0	0.00	-0.04	0.0205					-2.1	-16.0	-20.3	0.35	51.	20.	0.0 0. 0.08 RIME
1186	0.68	1.2	0.01	-0.06						-1.1	-10.6	-32.6	0.35	51.	20.	0.0 0. 0.08 RIME
1187	0.70	2.0	0.00	-0.02	0.0216					-1.1	-10.0	-33.0	0.64	38.	20.	0.0 0. 0.25 0.38
1188	0.69	2.0	0.00	-0.00	0.0399					0.0	-10.0	-32.4	0.64	38.	20.	0.0 0. 0.25 0.38

CONFIGURATION - 6, SC1012 R8 AIRFOIL

RUN	MACH	RN	ALPH	CLP	CLPL	CL40	CDW	CMP	L/D	TOT T	STA T	LAC TIME	DIA FREQ	AMP LENGTH	WIDTH	REMARKS
1189	0.59	2.1	5.70	0.96	0.91	0.88	0.0379	-0.047	25.4	-10.0	-27.1	0.58	45.	20.	0.0 0. 0.44 0.44	
1190	0.60	2.1	5.70	0.83	0.87	1.01	0.0450	-0.058	18.5	-10.0	-27.3	0.58	45.	20.	0.0 0. 0.44 0.44	
1191	0.59	1.9	6.01	0.94	0.90	0.91	0.0523	-0.045	17.9	10.0	-8.1				ONSET OF ICING	
1192	0.58	2.1	6.00	0.71	0.60	0.70	0.0118	-0.011	60.4	7.0	-10.7	0.58	20.		ONSET OF ICING	
1193	0.30	1.0	5.98	0.71	0.60	0.70	0.0110	-0.010	60.4	10.0	-3.5	0.66	20.			
1194	0.29	1.1	6.00	0.03	0.11	0.02	0.20	0.0110	-0.033	9.7	-1.1	-5.4				
1195	0.29	1.1	3.00	0.45	0.33	0.51	0.0105	-0.034	43.0	-1.1	-5.4					
1196	0.30	1.1	2.98	0.41	0.33	0.47	0.0323	-0.033	12.7	-1.1	-5.4					
1197	0.29	1.1	6.01	0.82	0.73	0.85	0.0122	-0.037	67.4	-10.0	-14.4					
1198	0.30	1.1	6.00	0.72	0.70	0.79	0.0333	-0.035	21.6	-10.0	-14.4	0.66	60.	20.	0.0 0. 0.06 0.19	
1199	0.30	1.1	6.01	0.85	0.80	0.88	0.0121	-0.040	70.2	-10.0	-14.4	0.66	60.	20.	0.0 0. 0.06 0.19	
1200	0.30	1.1	6.00	0.72	0.72	0.75	0.0319	-0.031	22.5	-10.0	-14.4	0.66	60.	11.	0.0 0. 0.06 ROUND	
1201	0.30	1.1	6.00	0.84	0.77	0.88	0.0120	-0.041	70.2	-10.0	-14.3					
1202	0.30	1.1	6.01	0.70	0.73	0.79	0.0354	-0.029	19.7	-10.0	-14.3	0.66	60.	35.	0.0 0. 0.09 ROUND	
1203	0.30	1.1	6.00	0.85	0.77	0.89	0.0116	-0.039	72.6	-10.0	-14.4	0.66	60.	50.	0.0 0. 0.19 0.28	
1204	0.30	1.1	6.01	0.70	0.66	0.75	0.0549	-0.037	12.8	-10.0	-14.3	0.66	60.	50.	0.0 0. 0.19 0.28	
1205	0.30	1.1	6.01	0.85	0.81	0.88	0.0118	-0.036	71.8	-10.0	-14.3	0.66	60.	50.	0.0 0. 0.14 0.25	
1206	0.30	1.1	6.01	0.70	0.73	0.77	0.0341	-0.034	11.1	-10.0	-14.3	0.66	60.	20.	0.0 0. 0.14 0.25	
1207	0.30	1.1	9.02	0.86	0.86	0.86	0.0791	-0.055	11.1	-10.0	-14.5				ICE FROM 1207	

APPENDIX A (CONT)

CONFIGURATION - 6, SC1012 R8 AIRFOIL

RUN	MACH	RN	ALPH	CLP	CLPL	CL40	CDW	CMP	L/D	TOT T	STA T	LWC TIME	DIA FREQ	AMP	LNGTH	WIDTH	REMARKS
1209	0.30	1.1	3.00	0.47	0.39	0.51	0.0199	-0.028	23.8	-10.0	-14.4						ICE FROM 1207
1210	0.30	1.1	-0.01	0.18	0.05	0.19	0.0192	-0.018	9.6	-10.0	-14.4						ICE FROM 1207
1211	0.17	1.1	6.01	0.79	0.72	0.87	0.1344	-0.025	5.9	-10.0	-14.4						ICE FROM 1207
1212	0.27	1.1	6.01	0.85	0.80	0.87	0.0101	-0.053	29.6	-10.7	-14.5						ICE FROM 1213
1213	0.29	1.1	5.99	0.76	0.71	0.86	0.0222	-0.031	34.3	-10.0	-14.3	0.35	60.	20.	5.0	9.	0.03 RIME
1214	0.29	1.1	9.03	1.07	1.08	1.09	0.0272	-0.033	39.5	-10.0	-14.3						ICE FROM 1213
1215	0.30	1.1	3.01	0.49	0.38	0.51	0.0156	-0.032	31.5	-10.0	-14.4						ICE FROM 1213
1216	0.29	1.1	0.0	0.17	0.04	0.15	0.0151	-0.022	11.3	-10.0	-14.3						ICE FROM 1213
1217	0.30	1.1	6.00	0.81	0.77	0.85	0.0126	-0.034	64.7	-10.0	-14.3						ICE FROM 1213
1218	0.30	1.1	6.01	0.77	0.74	0.85	0.0242	-0.036	31.6	-10.0	-14.3	0.35	60.	20.	0.0	0.	0.03 RIME
1219	0.40	1.5	6.00	0.88	0.78	0.90	0.0121	-0.043	72.7	-10.0	-17.6						ICE FROM 1222
1220	0.38	1.5	6.00	0.50	0.55	0.65	0.1362	-0.086	3.6	-10.0	-17.4	1.75	60.	20.	0.0	0.	0.36 0.76
1221	0.40	1.5	6.01	0.86	0.80	0.90	0.0122	-0.042	71.1	-10.0	-17.6						ICE FROM 1222
1222	0.40	1.5	6.02	0.70	0.72	0.80	0.0600	-0.036	17.6	-10.0	-17.9	0.62	60.	20.	0.0	0.	0.25 0.19
1223	0.40	1.5	9.01	0.84	0.94	0.87	0.0660	-0.052	12.8	-10.0	-17.9						ICE FROM 1222
1224	0.39	1.5	2.99	0.45	0.41	0.53	0.0263	-0.035	17.2	-10.0	-17.6						ICE FROM 1222
1225	0.39	1.5	0.0	0.15	0.04	0.20	0.0244	-0.027	6.2	-10.0	-17.6						ICE FROM 1222
1226	0.30	1.1	12.01	1.46	1.41	1.44	0.0215	-0.037	68.2	-10.0	-14.4						ICE FROM 1222
1227	0.30	1.1	12.03	0.98	0.90	1.04	0.1168	-0.117	8.4	-10.0	-14.4	0.66	60.	20.	0.0	0.	0.13 0.25
1228	0.69	2.3	0.0	0.13	0.04	0.24	0.199	-0.052	6.7	-10.0	-32.3						ICE FROM 1222
1229	0.69	2.3	0.0	0.04	0.02	0.25	0.0546	-0.051	0.7	-10.0	-32.6	0.64	45.	20.	0.0	0.	0.31 0.52
1230	0.60	2.1	6.01	0.94	0.96	0.89	0.0446	-0.041	21.0	-10.0	-27.5						ICE FROM 1222
1231	0.61	2.1	5.99	0.61	0.94	0.92	0.0537	-0.051	15.2	-10.0	-28.1	0.58	45.	20.	0.0	0.	0.28 0.38
1232	0.59	2.1	6.00	0.96	0.98	0.92	0.0400	-0.039	23.9	-10.0	-27.0						ICE FROM 1222
1233	0.59	2.1	5.98	0.88	0.97	0.98	0.0464	-0.052	19.0	-10.0	-27.3	0.58	45.	11.	0.0	0.	0.25 0.30
1234	0.59	2.1	6.00	0.93	0.94	0.88	0.0374	-0.037	24.9	-10.0	-27.3						ICE FROM 1222
1235	0.60	2.1	6.00	0.79	0.92	0.97	0.0503	-0.058	15.8	-10.0	-27.4	0.58	45.	35.	0.0	0.	0.28 0.41
1236	0.59	2.1	6.01	0.96	0.95	0.90	0.0386	-0.039	24.9	-10.0	-26.9						ICE FROM 1222
1237	0.60	2.1	6.01	0.79	0.94	1.03	0.0529	-0.061	14.9	-10.0	-27.4	0.58	45.	50.	0.0	0.	0.31 0.44
1238	0.40	1.5	6.00	0.90	0.81	0.93	0.0136	-0.040	66.1	-10.0	-17.6						ICE FROM 1222
1239	0.42	1.6	5.99	0.50	0.49	0.67	0.1321	-0.084	3.8	-10.0	-16.6	1.53	60.	20.	0.0	0.	0.34 0.78
1240	0.30	1.1	-0.02	0.19	0.14	0.17	0.0123	-0.022	15.7	-10.0	-14.5						ICE FROM 1222
1241	0.30	1.1	-0.03	0.16	0.12	0.19	0.0288	-0.024	5.4	-10.0	-14.5	0.66	20.	20.	0.0	0.	0.05 ROUND
1242	0.30	1.1	-0.01	0.19	0.12	0.16	0.0126	-0.022	15.2	-10.0	-14.4						ICE FROM 1222
1243	0.30	1.1	-0.02	0.17	0.09	0.18	0.0277	-0.025	6.1	-10.0	-14.4	0.66	45.	20.	0.0	0.	0.05 ROUND
1244	0.59	2.1	6.01	0.98	0.97	0.91	0.0385	-0.035	25.4	-10.0	-27.0						ICE FROM 1222
1245	0.59	2.1	6.01	0.84	0.87	1.01	0.0476	-0.048	17.7	-10.0	-27.0	*	60.	20.	0.0	0.	0.26 0.38 SIMULATED CLOUD
1246	0.30	1.1	6.02	0.83	0.78	0.87	0.0124	-0.034	67.4	-10.0	-14.4						ICE FROM 1222
1247	0.29	1.1	6.01	0.70	0.65	0.74	0.0475	-0.034	14.8	-10.0	-14.3	*	60.	20.	0.0	0.	0.09 ROUND SIMULATED CLOUD

* LIQUID WATER CONTENT INCREASED FROM 0 TO 1.00 G/CU M
AT THE 30 SECOND POINT AND THEN BACK TO 0G/CU M

CONFIGURATION - 5, SCI10% R8 AIRFOIL

APPENDIX A (CONT)

RUN	MACH	RN	ALPH	CLP	CLPL	CL40	CDW	CMP	L/D	TOT T	STA T	LWC TIME	DIA FREQ AMP	LNGTH WIDTH	REMARKS
1248	0.58	2.1	6.00							6.4	-11.2	0.58	20.		ONSET OF ICING
1249	0.58	2.1	6.00							6.4	-11.2	0.58	11.		ONSET OF ICING
1250	0.58	2.1	6.00							7.1	-10.6	0.58	35.		ONSET OF ICING
1251	0.58	2.1	6.00							7.3	-10.4	0.58	50.		ONSET OF ICING
1252	0.58	2.1	6.00							7.4	-10.5	0.58	70.		ONSET OF ICING NO DATA
1253	TO 1256														
1257	0.30	1.0	5.89	0.45	0.61	0.78	0.0126	-0.068	36.3	30.0	24.8				
1258	0.30	1.1	-0.02	0.10	-0.00	0.13	0.0109	-0.020	9.3	-10.0	-14.3				
1259	0.30	1.1	-1.98	0.00	-0.22	-0.11	0.0115	0.003	0.3	-10.0	-14.3				
1260	0.30	1.1	0.01	0.15	0.06	0.12	0.0112	-0.011	13.5	-10.0	-14.3				
1261	0.30	1.1	3.00	0.38	0.32	0.43	0.0102	-0.036	36.7	-10.0	-14.3				
1262	0.30	1.1	6.00	0.64	0.35	0.81	0.0126	-0.053	50.6	-10.0	-14.3				
1263	0.30	1.1	8.97	0.85	1.04	1.10	0.0151	-0.071	56.1	-10.0	-14.4				
1264	0.30	1.1	11.97	1.05	1.41	1.38	0.0205	-0.085	50.9	-10.0	-14.3				
1265	0.30	1.1	12.98	1.09	1.48	1.41	0.0232	-0.081	46.9	-10.0	-14.3				
1266	0.30	1.1	13.96	1.13	1.52	1.43	0.0262	-0.095	45.8	-10.0	-14.3				
1267	0.30	1.1	14.97	1.16	1.56	1.44	0.0308	-0.104	39.7	-10.0	-14.4				
1268	0.30	1.1	15.97	1.20	1.55	1.45	0.0414	-0.116	32.5	-10.0	-14.3				
1269	0.30	1.1	16.97	1.21	1.56	1.41	0.0610	-0.135	25.9	-10.0	-14.4				
1270	0.30	1.1	17.96	1.21	1.55	1.45	0.1175	-0.172	11.7	-10.0	-14.4				
1271	0.29	1.1	0.0	0.36	0.03	0.38	0.0103	-0.055	34.9	-10.0	-13.8				
1272	0.30	1.1	0.00	0.07	0.01	0.10	0.0108	-0.015	6.6	-10.0	-14.3				
1273	0.28	1.1	0.01	0.17	0.02	0.15	0.0292	-0.021	6.7	-10.2	-14.3				
1274	0.28	1.1	0.02	0.06	0.03	0.07	0.0096	-0.028	1.5	-10.2	-14.5				
1275	0.30	1.1	0.00	0.13	0.02	0.12	0.0196	-0.022	6.4	-10.0	-14.2				
1276	0.30	1.1	3.02	0.30	0.28	0.31	0.0200	-0.038	15.2	-10.0	-14.3				
1277	0.30	1.1	6.00	0.56	0.68	0.75	0.0283	-0.052	7.5	-10.0	-14.6				
1278	0.29	1.0	3.03	0.54	0.26	0.74	0.0105	-0.093	50.9	-10.0	-13.6				
1279	0.30	1.1	3.03	0.34	0.04	0.45	0.0252	-0.029	13.6	-10.0	-14.4				
1280	0.30	1.1	6.02	0.53	0.72	0.79	0.0113	-0.069	47.1	-10.0	-14.3				
1281	0.30	1.1	6.03	0.51	0.64	0.75	0.0347	-0.055	14.7	-10.0	-14.3				
1282	0.30	1.1	6.92	0.55	0.76	0.79	0.0117	-0.080	47.3	-10.0	-14.3				
1283	0.29	1.1	6.01	0.66	0.41	0.89	0.0308	-0.086	21.5	-10.0	-13.8				
1284	0.30	1.1	9.03	0.74	0.87	0.99	0.0428	-0.063	17.3	-10.0	-14.4				
1285	0.30	1.1	3.00	0.41	0.39	0.53	0.0185	-0.037	22.2	-10.0	-14.3				
1286	0.30	1.1	-0.01	0.17	0.05	0.14	0.0172	-0.019	9.9	-10.0	-14.4				
1287	0.29	1.0	6.00	0.82	0.76	1.18	0.0119	-0.134	68.6	-10.0	-13.5				
1288	0.30	1.1	6.00	0.60	0.65	0.85	0.0275	-0.057	21.6	-10.0	-14.3				
1289	0.28	1.0	6.01	0.71	0.72	1.02	0.0118	-0.136	60.2	-2.0	-5.7				
1290	0.29	1.1	6.01	0.55	0.76	0.68	0.0457	-0.056	12.1	-2.0	-6.3				
1291	0.29	1.0	9.03	0.91	0.96	1.31	0.0147	-0.133	62.1	-10.0	-13.7				
1292	0.29	1.0	9.04	0.93	0.66	1.18	0.0875	-0.123	10.6	-10.0	-13.8				
1293	0.30	1.1	12.03	0.88	1.40	1.33	0.0197	-0.103	44.7	-10.0	-14.4				
1294	0.30	1.2	12.04	0.86	0.97	1.11	0.1256	-0.142	6.8	-10.0	-14.6				
1295	0.39	1.5	0.01	0.08	0.06	0.13	0.0112	-0.026	7.3	-10.0	-17.8				
1296	0.39	1.4	-2.01	0.07	-0.12	-0.02	0.0121	-0.019	5.4	-10.0	-17.0				
1297	0.39	1.5	0.01	0.20	0.02	0.23	0.0112	-0.014	17.7	-10.0	-17.0				

APPENDIX A (CONT)

CONFIGURATION - 5, SC1094 R8 AIRFOIL

RUN	MACH	RN	ALPH	CLP	CLPL	CL40	CDW	CMP	L/D	TOT T	STA T	LWC TIME	DIA FREQ	AMP	LNGTH	WIDTH	REMARKS
1298	0.38	1.5	3.01	0.35	0.37	0.40	0.0105	-0.033	6.9	-10.2	-17.7						ONLINE DATA ONLY
1299	0.38	1.5	6.02	0.64	0.60	0.79	0.0129	-0.062	8.3	-10.2	-17.8						ONLINE DATA ONLY
1300	0.39	1.5	9.03	0.87	1.11	1.08	0.0164	-0.069	53.0	-10.0	-17.7						
1301	0.38	1.4	6.01	0.76	0.60	0.91	0.0131	-0.070	57.9	-10.0	-17.0						
1302	0.39	1.5	11.03	0.99	1.36	1.28	0.0228	-0.079	43.2	-10.0	-17.7						
1303	0.39	1.5	12.03	1.03	1.38	1.31	0.0255	-0.079	40.2	-10.0	-17.5						
1304	0.39	1.5	13.03	1.02	1.48	1.37	0.0347	-0.087	30.5	-10.0	-17.9						
1305	0.39	1.5	14.04	1.14	1.03	1.36	0.0983	-0.119	12.5	-10.0	-17.8						
1306	0.39	1.5	15.04	1.26	1.27	1.67	0.1680	-0.146	8.2	-10.0	-17.5						
1307	0.38	1.4	0.0	0.31	0.02	0.29	0.0111	-0.033	28.0	-10.0	-16.9						
1308	0.38	1.4	6.02	0.76	0.73	1.00	0.0131	-0.081	58.1	-10.0	-17.0						
1309	0.38	1.4	6.00	0.73	0.70	0.95	0.0589	-0.070	18.8	-10.0	-16.8						
1310	0.37	1.4	9.04	0.76	0.57	0.90	0.0580	-0.070	13.1	-10.0	-16.8						ICE FROM 1309
1311	0.38	1.4	2.99	0.53	0.35	0.65	0.0275	-0.053	19.4	-10.0	-16.9						ICE FROM 1309

CONFIGURATION - 6, SC1012 R8 AIRFOIL

RUN	MACH	RN	ALPH	CLP	CLPL	CL40	CDW	CMP	L/D	TOT T	STA T	LWC TIME	DIA FREQ	AMP	LNGTH	WIDTH	REMARKS
1312	0.38	1.4	6.02	0.99	0.77	1.05	0.0130	-0.060	76.4	-10.0	-17.0						
1313	0.38	1.4	6.00	1.00	0.81	1.08	0.0127	-0.062	78.9	-10.0	-16.9						
1314	0.38	1.4	5.99	0.74	0.73	0.90	0.0721	-0.061	10.3	-10.0	-16.7						ICE FROM 1314
1315	0.39	1.5	8.99	0.89	0.56	1.11	0.0124	-0.121	8.5	-10.0	-17.2						ICE FROM 1314
1316	0.38	1.4	2.97	0.41	0.32	0.67	0.0610	-0.057	6.7	-10.0	-16.9						ICE FROM 1314
1317	0.38	1.4	-0.02	0.07	-0.01	-0.11	0.0878	-0.053	0.9	-10.0	-16.9						

CONFIGURATION - 5, SC1094 R8 AIRFOIL

RUN	MACH	RN	ALPH	CLP	CLPL	CL40	CDW	CMP	L/D	TOT T	STA T	LWC TIME	DIA FREQ	AMP	LNGTH	WIDTH	REMARKS
1318	0.39	1.4	6.03	0.55	0.80	0.91	0.0128	-0.081	42.6	-10.0	-16.9						
1319	0.38	1.4	6.02	0.78	0.77	1.02	0.0127	-0.074	61.3	-10.0	-16.9						
1320	0.39	1.5	6.01	0.58	0.75	0.72	0.0423	-0.043	13.7	-10.0	-17.4						
1321	0.38	1.4	6.01	0.59	0.78	0.90	0.0131	-0.080	44.8	-10.0	-16.9						
1322	0.39	1.4	6.02	0.62	0.75	0.84	0.0278	-0.060	22.3	-10.0	-17.0						
1323	0.38	1.4	6.00	0.58	0.81	0.91	0.0132	-0.078	43.7	-10.0	-16.7						
1324	0.38	1.4	6.02	0.63	0.75	0.88	0.0434	-0.061	14.5	-10.0	-16.8						
1325	0.38	1.4	6.01	0.56	0.80	0.93	0.0128	-0.085	43.6	-10.0	-16.9						
1326	0.38	1.4	6.00	0.61	0.70	0.87	0.0514	-0.062	11.8	-10.0	-16.8						
1327	0.38	1.4	6.02	0.61	0.80	0.92	0.0127	-0.079	48.2	-10.0	-16.9						0.14
1328	0.39	1.4	6.00	0.66	0.82	0.92	0.0280	-0.063	23.5	-10.0	-16.9						RIME
1329	0.38	1.4	6.01	0.53	0.76	0.91	0.0129	-0.086	40.7	-10.0	-16.9						
1330	0.38	1.4	6.01	0.63	0.71	0.88	0.0277	-0.059	22.8	-10.0	-17.0						
1331	0.39	1.5	9.03	0.83	1.04	1.16	0.0360	-0.078	23.1	-10.0	-17.2						
1332	0.38	1.4	3.00	0.46	0.37	0.55	0.0171	-0.038	26.8	-10.0	-17.0						

CONFIGURATION - 5, SC1094 R8 AIRFOIL

APPENDIX A (CONT)

RUN	MACH	RN	ALPH	CIP	CLPL	CL40	CDW	CMP	L/D	TOT T	STA T	LWC TIME	DIA FREQ	AMP LNGTH	WIDTH	REMARKS
ICE FROM 1330																
1333	0.36	1.4	-0.01	0.20	0.03	0.17	0.0166	-0.013	12.4	-10.0	-16.9					
1334	0.38	1.4	9.03	0.75	1.18	1.18	0.0155	-0.105	48.4	-10.0	-17.0					
1335	0.39	1.4	9.02	0.82	0.96	1.13	0.0116	-0.032	7.2	-10.0	-17.0					
1336	0.46	1.7	0.02	0.08	0.01	0.13	0.0136	-0.001	-1.0	-10.0	-21.0					
1337	0.47	1.7	-2.00	-0.01	-0.17	-0.13	0.0122	-0.104	12.2	-10.0	-17.0					
1338	0.48	1.7	0.0	0.20	0.00	0.19	0.0112	-0.022	18.0	-10.0	-20.7					
1339	0.48	1.7	3.03	0.44	0.22	0.62	0.0109	-0.043	40.3	-10.0	-20.6					
1340	0.48	1.7	6.01	0.75	0.85	0.94	0.0137	-0.075	54.7	-10.0	-20.9					
1341	0.49	1.8	9.04	0.85	1.00	1.13	0.0402	-0.069	21.1	-10.0	-21.6					
1342	0.48	1.8	10.03	0.95	1.05	1.22	0.0545	-0.086	17.3	-10.0	-20.9					
1343	0.48	1.8	11.05	1.05	1.31	1.33	0.0653	-0.097	16.1	-10.0	-21.0					
1344	0.48	1.7	0.0	0.28	0.03	0.23	0.0115	-0.020	24.6	-10.0	-20.8					
1345	0.48	1.7	6.00	0.72	0.77	0.94	0.0143	-0.068	50.4	-10.0	-20.8					
1346	0.48	1.7	6.00	0.71	0.76	0.98	0.0485	-0.055	14.7	-10.0	-20.8					
1347	0.49	1.8	6.02	0.59	0.67	0.92	0.0140	-0.072	42.5	-10.0	-21.4					
1348	0.48	1.8	6.03	0.72	0.80	1.10	0.0260	-0.066	27.8	-10.0	-21.0					
1349	0.58	2.0	0.01	0.12	-0.01	0.15	0.0114	-0.028	10.2	-10.0	-25.7					
1350	0.58	2.0	-2.00	0.01	-0.13	-0.10	0.0199	-0.004	0.3	-10.0	-25.9					
1351	0.58	2.0	0.01	0.18	0.00	0.15	0.0112	-0.022	16.2	-10.0	-25.5					
1352	0.57	2.0	3.00	0.50	0.46	0.61	0.0118	-0.050	42.3	-10.0	-25.1					
1353	0.57	2.0	6.00	0.68	0.75	0.93	0.0282	-0.069	24.0	-10.0	-25.4					
1354	0.58	2.1	9.02	0.94	1.09	1.28	0.0858	-0.085	11.0	-10.0	-26.6					
1355	0.57	2.0	-0.01	0.28	0.01	0.23	0.0118	-0.013	24.1	-10.0	-25.4					
1356	0.58	2.0	6.03	0.70	0.83	0.97	0.0324	-0.073	21.8	-10.0	-25.5					
1357	0.58	2.1	6.03	0.75	0.79	0.94	0.0396	-0.064	19.0	-10.0	-26.3					
1358	0.58	2.1	6.01	0.54	0.86	0.93	0.0314	-0.086	17.3	-10.0	-26.4					
1359	0.59	2.1	6.01	0.65	0.94	0.95	0.0477	-0.060	13.7	-10.0	-26.8					
1360	0.58	2.1	6.01	0.58	0.88	0.94	0.0309	-0.088	19.0	-10.0	-25.8					
1361	0.59	2.1	6.01	0.68	0.83	0.89	0.0353	-0.061	19.3	-10.0	-26.8					
1362	0.48	1.8	6.01	0.68	0.89	1.02	0.0138	-0.069	49.1	-10.0	-20.9					
1363	0.47	1.8	6.02	0.62	0.47	0.91	0.1990	-0.088	3.1	-10.0	-20.7					
1364	0.48	1.8	9.01	0.76	0.50	1.02	0.1332	-0.151	5.8	-10.0	-21.2					
1365	0.48	1.7	3.00	0.29	0.32	0.13	0.1149	-0.033	2.6	-10.0	-20.8					
1366	0.48	1.7	0.01	-0.07	-0.03	-0.33	0.1498	-0.004	-0.6	-10.0	-20.8					
1367	0.57	1.9	6.00	0.53	0.93	0.98	0.0122	-0.073	48.3	10.0	-6.8					
1368	0.57	1.9	5.98	0.41	0.91	0.93	0.0333	-0.089	12.2	10.0	-7.3					
1369	0.58	1.9	6.00						6.3	-9.4	0.58	20.				
1370	0.29	1.0	6.00						1.7	-2.8	0.66	20.				
1371	0.27	0.9	5.98	0.64	0.73	1.25	0.0125	-0.145	51.0	10.0	6.6					
1372	0.28	1.0	2.97	0.39	0.31	0.80	0.0104	-0.107	37.2	-10.0	-13.4					
1373	0.28	1.0	3.00	0.28	0.29	0.58	0.0244	-0.099	11.5	-10.0	-13.4					
1374	0.58	2.1	2.98	0.25	0.28	0.66	0.0125	-0.072	19.9	-10.0	-26.1					
1375	0.59	2.1	2.99	0.22	0.46	0.64	0.0413	-0.064	5.4	-10.0	-26.7					
1376	0.58	2.1	6.01	0.40	0.75	0.93	0.0326	-0.086	12.2	-10.0	-26.6					
1377	0.58	2.1	5.99	0.44	0.87	1.01	0.0345	-0.102	12.7	-10.0	-26.1					
1378	0.58	2.1	6.00	0.42	0.81	0.93	0.0326	-0.095	12.8	-10.0	-26.1					
1379	0.59	2.1	6.01	0.31	0.75	0.83	0.0893	-0.099	3.5	-10.0	-27.0	1.12	45.	20.	0.41 0.63	

ONSET OF ICING
ONSET OF RIME

APPENDIX A (CONT.)

CONFIGURATION - 5, SC1095 R8 AIRFOIL

RUN	MACH	RN	ALPH	CLP	CLPL	CL40	CDW	CMP	L/D	TOT T	STA T	LWC TIME	DIA FREQ	AMP	LNGTH	WIDTH	REMARKS	
1380	0.58	2.1	5.99	0.42	0.85	0.96	0.0326	-0.096	12.9	-10.0	-26.4							
1381	0.55	2.0	5.98	0.32	0.54	0.98	0.1202	-0.098	2.7	-10.0	-25.2	1.31	45.	20.	0.0	0.44	0.63	
1382	0.59	2.1	6.01	0.39	0.86	0.90	0.0321	-0.088	12.1	-10.0	-26.6							
1383	0.58	2.1	5.99	0.39	0.92	0.94	0.0751	-0.111	5.2	-10.0	-26.3	1.50	45.	20.	0.0	0.42	0.54	
1384	0.59	2.1	6.01	0.38	0.96	0.87	0.0336	-0.086	11.2	-10.0	-27.1							
1385	0.58	2.1	5.99	0.33	0.57	0.94	0.1382	-0.121	2.5	-10.0	-26.6	1.31	45.	20.	5.0	9.	0.34	0.69
1386	0.55	2.0	8.99	0.58	0.63	1.19	0.1477	-0.184	4.1	-10.0	-24.4							
1387	0.58	2.1	2.98	0.04	0.41	0.30	0.1004	-0.062	0.4	-10.0	-26.3							
1388	0.58	2.1	-0.01	-0.29	-0.05	-0.35	0.1182	-0.026	-2.7	-10.0	-25.6							
1389	0.59	2.1	6.00	0.39	0.89	0.91	0.0341	-0.088	11.4	-10.0	-26.8							
1390	0.59	2.1	6.00	0.43	0.92	0.91	0.0363	-0.089	11.8	-10.0	-27.0	0.58	45.	20.	5.0	9.	0.16	0.30
1391	0.58	2.1	9.01	0.50	1.13	1.08	0.0479	-0.099	10.4	-10.0	-26.0							
1392	0.57	2.0	2.99	0.27	0.39	0.71	0.0317	-0.077	6.5	-10.0	-25.3							
1393	0.57	2.0	-0.01	-0.06	-0.03	0.18	0.0526	-0.061	-1.1	-10.0	-25.5							
1394	0.63	2.0	5.81	0.99	0.99	0.99	0.0304	-0.0304	37.6	14.1	-6.9							
1395	0.63	1.9	6.00	0.93	0.93	0.93	0.0326	-0.0326	28.5	3.6	-16.4							
1396																		NO DATA
1397	0.58	2.0	6.00	0.38	0.67	0.89	0.0338	-0.087	11.3	0.0	-17.1	0.58	45.	20.	0.0	0.	0.14	BEAK
1398	0.58	2.0	0.0	-0.02	-0.00	0.20	0.0123	-0.038	-1.8	-10.0	-25.5							
1399	0.57	2.0	0.01	-0.08	-0.01	0.16	0.0629	-0.055	-1.2	-10.0	-25.4	0.58	45.	20.	0.0	0.	0.28	0.44
1400	0.57	2.0	0.0	-0.02	-0.01	0.19	0.0118	-0.038	-1.3	-10.0	-25.5							
1401	0.57	2.1	0.0	-0.09	-0.03	0.12	0.0587	-0.046	-1.5	-10.0	-26.1	0.58	45.	20.	5.0	9.	0.22	0.38
1402	0.58	2.1	3.01	0.12	0.39	0.44	0.0424	-0.051	2.9	-10.0	-26.4							
1403	0.58	2.1	6.02	0.34	0.84	0.90	0.0769	-0.075	4.5	-10.0	-26.5							
1404	0.59	2.1	9.04	0.55	0.95	1.17	0.0978	-0.135	5.7	-10.0	-26.9							
1405	0.58	2.1	0.0	-0.04	0.01	0.14	0.0122	-0.036	-2.9	-10.0	-25.7							
1406	0.59	2.1	0.01	-0.03	0.02	0.15	0.0247	-0.033	-1.1	-10.0	-26.8	0.35	45.	20.	0.0	0.	0.13	0.28
1407	0.58	2.1	0.0	-0.03	0.03	0.18	0.0126	-0.030	-2.0	-10.0	-26.3							
1408	0.57	2.1	0.0	-0.02	0.01	0.20	0.0277	-0.030	-0.5	-10.0	-26.0	0.35	45.	20.	5.0	9.	0.16	0.22
1409	0.59	2.1	3.02	0.19	0.47	0.57	0.0216	-0.064	8.9	-10.0	-26.6							
1410	0.58	2.1	6.03	0.3	0.90	0.88	0.0340	-0.082	10.7	-10.0	-26.5							
1411	0.59	2.1	9.02	0.52	1.05	1.14	0.0677	-0.121	6.0	-10.0	-26.8							
1412	0.57	2.0	0.0	0.00	0.01	0.21	0.0122	-0.044	0.2	-10.0	-25.5	0.58	60.	20.	0.0	0.	0.13	0.31
1413	0.56	2.0	0.01	-0.25	-0.01	-0.22	0.0981	-0.029	-2.6	-10.0	-25.1							
1414	0.59	2.1	0.01	-0.02	0.03	0.14	0.0127	-0.036	-1.7	-10.0	-26.6							
1415	0.59	2.1	0.01	-0.01	0.00	0.21	0.0322	-0.031	-0.3	-10.0	-26.7	0.58	20.	20.	0.0	0.	0.13	0.31
1416	0.58	2.1	6.02	0.39	0.93	0.91	0.0304	-0.088	12.8	-10.0	-26.5							
1417	0.59	2.1	6.02	0.34	0.91	0.83	0.0648	-0.094	5.3	-10.0	-26.7	1.50	45.	20.	0.0	0.	0.44	0.50
1418	0.49	1.6	6.02	0.39	0.58	0.89	0.0141	-0.087	27.6	-10.0	-21.4							
1419	0.46	1.7	6.02	0.34	0.59	0.97	0.1264	-0.110	2.7	-10.0	-20.3	1.06	60.	20.	0.0	0.	0.41	0.63
1420	0.68	2.3	0.02	-0.01	0.00	0.21	0.0151	-0.038	-0.9	-10.0	-31.5							
1421	0.68	2.3	-0.99	-0.09	-0.08	0.05	0.0187	-0.029	-4.9	-10.0	-31.5							
1422	0.67	2.3	-0.01	-0.03	0.01	0.15	0.0144	-0.036	-2.0	-10.0	-32.0							
1423	0.67	2.3	2.02	0.16	0.31	0.54	0.0143	-0.063	11.1	-10.0	-30.6							
1424	0.68	2.3	0.0	-0.03	0.00	0.15	0.0141	-0.035	-2.3	-10.0	-31.9							
1425	0.63	2.2	0.0	-0.27	-0.11	-0.28	0.1066	-0.032	-2.7	-10.0	-28.6							

10

1. ICE ACCRETING ON AIRFOIL AT LOCATIONS THAT WERE DAMAGED BY DIRT IN TUNNEL. MODEL REMOVED FOR REPAIR AT RUN 87.
 2. ICE NOT SYMMETRICAL ACROSS TUNNEL. CLEANED NOZZLES AFTER RUN 96 AND ALTERED BAR FLOW RATES TO OBTAIN UNIFORM ICING (RUNS 98, 100 AND 102).

APPENDIX B

Run Log and Tabulated Test Data

OSU Simulated Ice Test

Description of Run Log/Data Headings

MACH	Free stream Mach number
RN	Model Reynolds number
ALPH	Model angle of attack, degrees
CLP	Lift coefficient calculated from integrated airfoil surface pressures
CLPL	Lift coefficient calculated from ceiling and floor static pressures
CL40	Lift coefficient calculated from airfoil static pressures at X/C of 40%
CDW	Drag coefficient calculated from wake momentum depression integration
CMP	Quarter chord pitching moment coefficient calculated from integrated airfoil surface pressures
L/D	Lift-drag ratio, CLP/CDW when CLP is available, otherwise CLPL/CDW
TOT T	Free stream total temperature, °C
STA T	Free stream static temperature, °C

APPENDIX B (CONT)

CONFIGURATION - 3, NACA 0012 AIRFOIL WITH ICE NO.2

RUN	MACH	RN	ALPH	CLP	CLPL	CL40	CDW	CMP	L/D	TOT T	STA T	REMARKS
1437	0.30	2.6	0.0	-0.01	-0.03	-0.05	0.0111	-0.005	-1.2	10.1	5.1	
1438	0.30	2.5	-2.00	-0.21	-0.24	-0.22	0.0121	-0.009	-17.2	4.8	-0.1	
1439	0.30	2.4	3.00	0.28	0.29	0.24	0.0108	0.0	25.9	5.3	0.3	
1440	0.30	2.2	6.00	0.55	0.56	0.49	0.0167	0.011	32.8	4.7	-0.3	
1441	0.30	1.9	-2.00	-0.24	-0.25	-0.27	0.0121	-0.001	-20.2	14.8	9.7	
1442	0.30	2.1	-2.00	-0.21	-0.24	-0.24	0.0122	-0.011	-17.0	8.5	3.5	
1443	0.30	2.2	0.0	-0.01	-0.04	-0.04	0.0104	-0.005	-1.4	6.1	1.1	
1444	0.30	2.3	9.00	0.78	0.78	0.66	0.0322	0.027	24.2	5.6	0.6	
1445	0.31	1.9	12.00	0.83	0.82	0.75	0.0782	-0.009	10.6	9.0	3.9	
1446	0.31	2.1	13.00	0.82	0.81	0.76	0.1237	-0.017	6.7	6.9	1.6	
1447	0.31	2.0	14.00	0.86	0.82	0.86	0.1298	-0.031	6.6	3.5	-1.7	
1448	0.31	2.1	15.00	0.85	0.78	1.05	0.1928	-0.082	4.4	2.3	-2.8	
1449	0.40	2.5	0.0	-0.02	-0.02	-0.05	0.0113	-0.006	-1.4	2.7	-6.0	
1450	0.40	2.5	6.00	0.56	0.62	0.51	0.0182	0.013	30.9	-0.3	-8.9	
1451	0.41	2.7	9.00	0.76	0.80	0.63	0.0376	0.029	20.3	-1.9	-10.7	
1452	0.41	2.8	11.00	0.79	0.82	0.69	0.0897	-0.006	8.8	-2.8	-11.6	
1453	0.41	2.9	13.00	0.65	0.65	0.62	0.1230	-0.037	6.9	-2.7	-11.5	
1454	0.40	2.6	6.00	0.57	0.62	0.51	0.0178	0.011	32.0	-3.3	-11.8	
1455	0.49	2.9	0.0	-0.02	-0.03	-0.05	0.0121	-0.005	-1.5	-1.8	-16.4	
1456	0.50	3.0	0.0	-0.01	-0.03	-0.04	0.0125	-0.007	-1.0	-2.1	-15.0	
1457	0.50	3.1	6.00	0.59	0.64	0.52	0.0193	0.014	30.4	-3.2	-16.0	
1458	0.51	3.3	9.00	0.73	0.78	0.58	0.0463	0.028	15.8	-4.0	-17.1	
1459	0.51	3.3	11.00	0.70	0.75	0.63	0.1016	-0.007	6.9	-2.6	-16.0	
1460	0.40	2.6	6.00	0.57	0.62	0.51	0.0174	0.012	32.5	-1.9	-10.5	
1461	0.58	3.1	0.0	-0.01	-0.02	-0.04	0.0127	-0.006	-0.8	-1.0	-18.3	
1462	0.60	4.0	0.0	-0.01	-0.03	-0.04	0.0128	-0.007	-0.8	-4.1	-22.0	
1463	0.60	3.8	3.00	0.31	0.35	0.28	0.0129	0.001	24.3	-5.0	-22.8	
1464												NO DATA
1465	0.59	3.4	6.00	0.61	0.66	0.54	0.0200	0.018	30.2	2.5	-15.5	
1466	0.60	3.9	9.00	0.66	0.70	0.53	0.0758	0.006	8.7	-1.1	-19.5	
1467	0.60	3.7	10.00	0.66	0.70	0.50	0.0741	0.011	8.9	-1.8	-20.0	
1468	0.60	3.7	10.00	0.65	0.69	0.55	0.0980	-0.006	6.6	-1.8	-20.1	
1469	0.71	4.0	-2.00	-0.25	-0.28	-0.27	0.0141	-0.017	-17.8	-0.3	-25.0	
1470	0.71	4.1	0.0	-0.02	-0.03	-0.04	0.0133	-0.008	-1.1	-3.1	-27.6	
1471	0.71	4.0	3.00	0.35	0.40	0.30	0.0149	0.005	23.7	-3.6	-28.0	
1472	0.71	4.1	6.00	0.67	0.74	0.63	0.0420	0.017	16.0	-3.5	-28.1	
1473	0.71	4.0	8.00	0.64	0.72	0.54	0.0850	-0.006	7.6	-3.0	-27.8	
1474	0.81	4.6	0.0	-0.01	-0.03	0.02	0.0174	-0.009	-0.8	7.6	-24.8	
1475	0.81	4.6	0.0	-0.01	-0.03	0.06	0.0168	-0.010	-0.7	-2.4	-33.7	
1476	0.81	4.5	1.00	0.15	0.16	0.58	0.0201	-0.015	7.6	-4.1	-35.2	
1477	0.81	4.4	2.00	0.29	0.31	0.74	0.0298	-0.020	9.7	-6.7	-37.4	
1478	0.81	4.5	5.00	0.46	0.51	0.58	0.0542	-0.011	8.4	-7.9	-38.4	
1479	0.81	4.1	6.00	0.49	0.54	0.46	0.0622	-0.009	7.9	1.4	-30.1	
1480	0.86	4.7	0.0	0.00	-0.02	-0.06	0.0143	-0.017	0.3	-4.8	-39.1	
1481	0.86	4.6	1.00	0.11	0.09	0.11	0.0219	-0.027	5.0	-5.0	-39.3	
1482	0.40	2.5	6.80	0.63	0.63	0.56	0.0207	0.017	30.6	-0.9	-9.5	

CONFIGURATION - 1, NACA 0012 AIRFOIL WITH NO ICE

RUN	MACH	RN	ALPH	CLP	CLPL	CL40	CDW	CMP	L/D	TOT T	STA T	REMARKS
1483	0.30	1.9	-2.00	-0.21	-0.26	-0.25	0.0069	-0.003	-30.0	5.0	0.1	
1484	0.30	2.1	-2.00	-0.21	-0.25	-0.24	0.0073	-0.003	-28.2	2.0	-2.9	
1485	0.30	2.0	0.0	0.00	-0.04	-0.04	0.0069	-0.004	0.6	0.4	-4.4	
1486	0.30	2.0	3.00	0.31	0.30	0.25	0.0067	0.0	45.8	-0.6	-5.4	

APPENDIX B (CONT)

CONFIGURATION - 1, NACA 0012 AIRFOIL WITH NO ICE

RUN	MACH	RN	ALPH	CLP	CLPL	CL40	CDW	CMP	L/D	TOT T	STA T	REMARKS
1487	0.30	2.1	6.00	0.63	0.60	0.57	0.0084	0.003	74.6	-1.2	-6.0	
1488	0.30	2.1	9.00	0.94	0.91	0.87	0.0101	0.007	92.8	-1.5	-6.3	
1489	0.30	2.0	12.00	1.18	1.17	1.11	0.0152	0.014	77.5	-1.7	-6.5	
1490	0.29	1.6	13.00	1.22	1.25	1.11	0.0193	0.016	63.4	10.8	6.0	
1491	0.30	2.0	13.00	1.24	1.24	1.12	0.0196	0.017	63.3	5.8	0.7	
1492	0.30	2.0	14.00	1.27	1.28	1.13	0.0284	0.022	44.7	3.1	-1.9	
1493	0.31	2.1	15.00	0.91	1.13	1.09	0.1770	-0.108	5.1	2.4	-2.7	
1494	0.41	2.6	0.0	-0.00	-0.07	-0.05	0.0074	-0.002	-0.7	2.7	-6.1	
1495	0.40	2.7	6.00	0.65	0.62	0.60	0.0083	0.001	78.2	0.2	-8.5	
1496	0.41	2.7	9.00	0.97	0.94	0.90	0.0111	0.009	87.3	-1.2	-9.9	
1497	0.41	2.8	11.00	1.10	1.08	0.99	0.0210	0.023	52.5	-2.0	-10.7	
1498	0.41	2.8	13.00	0.98	0.98	0.92	0.1089	-0.023	9.0	-2.0	-11.0	
1499	0.50	3.0	0.0	0.00	-0.03	-0.04	0.0075	-0.002	0.2	-0.1	-13.0	
1500	0.50	3.1	6.00	0.67	0.70	0.61	0.0092	0.005	72.5	-0.9	-13.9	
1501	0.51	3.2	9.00	0.93	0.98	0.81	0.0198	0.023	46.9	-1.7	-15.0	
1502	0.51	3.4	11.00	0.95	0.99	0.85	0.0614	0.013	15.5	-2.5	-15.9	
1503	0.61	3.3	0.0	-0.00	-0.03	-0.05	0.0075	-0.002	-0.2	13.5	-6.3	
1504	0.61	3.5	0.0	-0.00	-0.03	-0.05	0.0078	-0.003	-0.2	5.4	-13.9	
1505	0.61	3.8	3.00	0.37	0.39	0.32	0.0081	0.0	45.1	0.9	-18.1	
1506	0.61	3.8	6.00	0.73	0.76	0.61	0.0135	0.015	54.0	-1.4	-20.4	
1507	0.62	3.7	9.00	0.87	0.92	0.86	0.0546	0.005	16.0	0.4	-18.9	
1508	0.62	3.7	10.00	0.84	0.88	0.85	0.0872	-0.006	9.6	-2.4	-21.6	
1509	0.71	4.1	0.0	0.00	-0.02	-0.04	0.0076	-0.003	0.3	-2.4	-27.0	
1510	0.71	4.1	3.00	0.42	0.44	0.30	0.0101	0.004	41.7	-5.0	-29.4	
1511	0.71	4.2	6.00	0.75	0.81	1.08	0.0487	-0.001	15.3	-4.3	-28.9	
1512	0.81	4.4	0.0	-0.00	-0.04	-0.04	0.0116	-0.004	-0.3	-4.3	-35.5	
1513	0.81	4.3	2.00	0.36	0.37	0.79	0.0268	-0.030	13.5	-6.0	-36.8	
1514	0.81	4.3	5.00	0.59	0.68	0.58	0.0701	-0.057	8.5	-4.3	-35.4	
1515	0.86	4.5	0.0	-0.02	-0.04	-0.07	0.0110	0.0	-1.3	-6.1	-40.3	

CONFIGURATION - 8, SSC-A09 AIRFOIL WITH NO ICE

RUN	MACH	RN	ALPH	CLP	CLPL	CL40	CDW	CMP	L/D	TOT T	STA T	REMARKS
1516	0.40	2.3	6.00		0.75	0.80	0.0082		91.5	19.7	10.6	
1517	0.40	2.7	6.00		0.74	0.78	0.0083		89.2	3.5	-5.2	
1518	0.40	2.4	6.00	0.74	0.73	0.65	0.0084	-0.033	88.0	10.4	1.5	
1519	0.40	2.7	7.00	0.85	0.85	0.75	0.0089	-0.040	95.2	5.8	-2.7	
1520	0.40	2.9	6.80	0.85	0.83	0.77	0.0038	-0.043	96.2	3.0	-5.4	
1521	0.29	1.7	6.80	0.80	0.85	0.74	0.0098	-0.055	82.0	10.0	5.2	
1522	0.30	2.0	6.80	0.82	0.80	0.75	0.0095	-0.060	87.2	5.6	0.8	
1523	0.29	2.0	0.40	0.17	0.07	0.11	0.0075	-0.036	22.4	3.4	-1.3	
1524	0.30	2.2	3.70	0.50	0.46	0.42	0.0077	-0.046	65.5	0.0	-4.7	
1525	0.30	2.2	11.00	1.21	1.22	1.07	0.0169	-0.028	66.9	-2.0	-6.7	
1526	0.30	1.9	11.00	1.20	0.97	1.08		-0.029		20.9	15.8	
1527	0.30	1.9	11.00	1.17	1.11	1.05		-0.018		14.6	9.6	
1528	0.30	2.3	11.00	1.20	1.14	1.09	0.0162	-0.025	70.3	18.9	13.7	
1529	0.30	2.0	11.00	1.19	1.29	1.09	0.0149	-0.023	76.0	13.6	8.6	
1530	0.30	2.0	11.00	1.25	1.18	1.15	0.0211	-0.027	56.1	13.1	8.2	
1531	0.30	1.9	13.20	1.16	0.89	1.07	0.0640	-0.030	17.1	10.1	5.1	
1532	0.30	2.1	14.30	1.15	1.00	1.13	0.1342	-0.057	8.1	9.3	4.3	
1533	0.40	2.5	6.80	0.80	0.77	0.72	0.0088	-0.034	91.2	9.0	0.2	
1534	0.40	2.5	6.80	0.81	0.76	0.73	0.0092	-0.035	88.5	6.4	-2.2	
1535	0.49	2.7	0.40	0.15	-0.13	0.08	0.0071	-0.008	20.9	10.9	-2.4	
1536	0.50	3.1	3.70	0.51	0.36	0.44	0.0074	-0.018	69.2	8.6	-4.8	

APPENDIX B (CONT)

CONFIGURATION - 8, SSC-A09 AIRFOIL WITH NO ICE

RUN	MACH	RN	ALPH	CLP	CLPL	CL40	CDW	CMP	L/D	TOT T	STA T	REMARKS
1537	0.50	2.9	6.80	0.86	0.71	0.76	0.0095	-0.025	90.0	6.3	-6.9	
1538	0.50	2.8	11.00	1.09	1.04	0.95	0.0498	-0.027	21.8	6.4	-6.8	
1539	0.50	3.1	12.10	1.05	1.09	1.00	0.0944	-0.044	11.1	5.0	-8.5	
1540	0.57	3.6	-2.00	-0.14	-0.40	-0.18	0.0083	0.0	-16.6	4.8	-12.4	
1541	0.57	4.0	0.40	0.16	0.14	0.12	0.0073	-0.007	22.4	1.4	-15.5	
1542	0.58	3.6	0.40	0.16	0.01	0.11	0.0074	-0.007	21.6	-0.9	-17.9	
1543	0.58	3.6	3.70	0.56	0.52	0.49	0.0078	-0.016	71.8	-0.7	-17.7	
1544	0.58	3.6	6.80	0.88	0.89	0.77	0.0153	-0.015	57.8	-0.9	-18.0	
1545	0.58	3.5	9.90	1.03	1.01	0.99	0.0699	-0.030	14.8	-0.5	-17.9	
1546	0.66	4.3	0.40	0.17	0.05	0.13	0.0077	-0.007	22.3	-1.0	-22.6	
1547	0.67	4.3	0.40	0.17	0.07	0.13	0.0075	-0.006	23.1	-1.7	-23.8	
1548	0.68	4.1	0.40	0.18	0.04	0.13	0.0076	-0.006	23.3	-0.5	-23.8	
1549	0.69	4.1	3.70	0.61	0.58	0.48	0.0136	-0.009	44.8	-1.7	-25.0	
1550	0.69	4.3	6.80	0.91	0.91	0.81	0.0488	-0.025	18.6	-2.9	-26.4	
1551	0.71	4.1	0.40	0.18	0.10	0.15	0.0074	-0.006	24.2	-2.6	-27.6	
1552	0.73	4.1	0.40	0.18	0.13	0.15	0.0073	-0.007	24.8	-3.2	-28.9	
1553	0.73	3.6	0.40	0.18	0.06	0.14	0.0075	-0.006	23.8	7.7	-19.3	
1554	0.78	3.8	0.40	0.19	0.18	0.17	0.0075	-0.006	26.1	2.7	-27.0	
1555	0.80	4.1	0.40	0.21	0.14	0.14	0.0083	-0.006	25.2	1.5	-29.3	
1556	0.82	4.0	0.40	0.24	0.11	0.44	0.0081	-0.008	29.2	3.6	-29.0	
1557	0.84	4.2	0.40	0.27	0.25	0.42	0.0109	-0.023	24.6	1.3	-32.6	
1558	0.86	4.2	0.40	0.29	0.25	0.33	0.0202	-0.051	14.2	-0.0	-35.3	
1559	0.50	3.1	9.90	1.08	1.17	0.94	0.0277	-0.015	39.0	2.1	-11.1	
1560	0.29	1.8	9.90	1.04	0.87	0.96	0.0137	-0.063	76.0	2.7	-2.0	

CONFIGURATION - 3, NACA 0012 AIRFOIL WITH ICE NO.2

RUN	MACH	RN	ALPH	CLP	CLPL	CL40	CDW	CMP	L/D	TOT T	STA T	REMARKS
1561	0.30	1.7	6.60	0.58	0.66	0.54	0.0156	0.010	37.5	16.8	11.9	
1562	0.30	1.9	6.60	0.59	0.80	0.55	0.0161	0.008	36.4	12.5	7.5	
1563	0.39	2.5	6.60	0.60	0.64	0.56	0.0176	0.010	34.1	10.0	1.7	
1564	0.39	2.5	9.70	0.77	0.82	0.70	0.0364	0.017	21.2	6.9	-1.3	
1565	0.39	2.5	3.30	0.32	0.34	0.29	0.0133	0.001	24.4	6.8	-1.3	
1566	0.49	3.1	6.60	0.64	0.74	0.60	0.0188	0.013	33.9	4.7	-8.2	

CONFIGURATION - 5, SC1095 AIRFOIL WITH NO ICE

RUN	MACH	RN	ALPH	CLP	CLPL	CL40	CDW	CMP	L/D	TOT T	STA T	REMARKS
1567	0.50	3.1	6.60	0.79	0.76	0.77	0.0103	-0.014	76.8	8.8	-4.7	
1568	0.50	3.0	9.90	1.01	1.06	0.95	0.0410	-0.011	24.7	7.5	-6.0	
1569	0.50	3.1	12.00	1.06	1.04	1.02	0.0826	-0.028	12.8	4.6	-8.8	
1570	0.37	1.8	6.60	0.75	-0.62	0.76	0.0095	-0.022	79.3	13.0	5.5	
1571	0.39	2.6	6.60	0.77	0.71	0.78	0.0090	-0.024	85.7	7.6	-0.6	
1572	0.30	2.1	6.60	0.71	0.66	0.73	0.0093	-0.019	76.5	6.1	1.2	
1573	0.30	2.0	3.30	0.42	-0.10	0.44	0.0079	-0.017	52.3	3.6	-1.1	
1574	0.30	2.0	0.0	0.09	-0.27	0.09	0.0079	-0.014	11.6	2.7	-2.0	
1575	0.30	2.1	9.90	1.01	1.15	1.07	0.0119	-0.034	84.8	4.3	-0.5	
1576	0.30	2.0	12.00	1.16	1.15	1.22	0.0171	-0.043	67.7	5.7	0.8	
1577	0.30	2.1	13.00	1.21	1.23	1.29	0.0209	-0.044	57.9	4.0	-0.9	
1578	0.30	2.1	14.00	1.04	0.86	1.29	0.1058	-0.116	9.8	2.1	-2.8	
1579	0.57	3.4	-2.00	-0.14	-0.18	-0.17	0.0079	-0.005	-17.8	3.3	-13.9	
1580	0.58	3.7	0.0	0.10	0.15	0.07	0.0075	-0.007	13.0	0.0	-17.0	

APPENDIX B (CONT)

CONFIGURATION - 5, SC1095 AIRFOIL WITH NO ICE

RUN	MACH	RN	ALPH	CLP	CLPL	CL40	CDW	CMP	L/D	TOT T	STA T	REMARKS
1581	0.51	2.1	3.30	0.45	0.61	0.41	0.0072	-0.012	62.8	16.7	2.1	
1582	0.58	3.4	3.30	0.49	0.51	0.46	0.0077	-0.012	63.5	8.6	-9.0	
1583	0.58	3.4	6.60	0.82	0.87	0.74	0.0214	-0.005	38.7	3.9	-13.5	
1584	0.58	3.5	9.90	0.95	1.10	0.97	0.0811	-0.036	11.7	1.8	-15.6	
1585	0.68	4.3	0.0	0.11	0.07	0.09	0.0076	-0.009	13.8	0.4	-23.0	
1586	0.69	4.1	3.30	0.55	0.59	0.45	0.0137	-0.006	40.2	-1.1	-24.6	
1587	0.69	4.1	6.60	0.88	0.91	0.99	0.0587	-0.018	15.0	-2.9	-26.4	
1588	0.73	4.3	0.0	0.11	0.12	0.10	0.0077	-0.011	14.6	-3.2	-29.1	
1589	0.78	4.4	0.0	0.12	0.13	0.11	0.0078	-0.013	15.3	-4.9	-33.8	
1590	0.80	4.4	0.0	0.13	0.16	0.06	0.0077	-0.013	17.4	-6.3	-36.4	
1591	0.82	4.6	0.0	0.15	0.12	0.50	0.0071	-0.018	21.5	-6.7	-38.2	
1592	0.84	4.6	0.0	0.15	0.14	0.54	0.0121	-0.027	12.5	-6.5	-39.6	
1593	0.87	4.6	0.0	0.18	0.15	0.56	0.0151	-0.053	12.1	-6.3	-41.0	

CONFIGURATION - 2, NACA 0012 AIRFOIL WITH ICE NO.1

RUN	MACH	RN	ALPH	CLP	CLPL	CL40	CDW	CMP	L/D	TOT T	STA T	REMARKS
1594	0.69	3.9	0.0	-0.02	-0.13	-0.06	0.0095	-0.005	-2.6	6.8	-17.1	
1595	0.57	3.5	0.0	-0.02	-0.07	-0.06	0.0093	-0.004	-2.7	1.1	-15.8	
1596	0.57	3.5	3.30	0.36	0.32	0.32	0.0101	0.004	35.9	-2.2	-18.7	
1597	0.57	3.6	6.60	0.73	0.70	0.64	0.0170	0.019	43.0	-5.4	-21.9	
1598	0.58	3.6	9.70	0.88	0.94	0.75	0.0566	0.016	15.6	-6.0	-22.6	
1599												NO DATA
1600	0.50	3.0	9.70	0.94	0.88	0.80	0.0343	0.024	27.4	6.4	-6.7	
1601	0.49	3.1	0.0	-0.03		-0.06	0.0094	-0.005	-2.8	4.2	-8.6	
1602	0.49	3.0	6.60	0.71		0.65	0.0136	0.012	52.5	0.0	-12.7	
1603	0.39	2.9	6.60	0.67		0.62	0.0126	0.008	52.8	2.2	-5.9	
1604	0.38	2.4	6.60	0.69		0.63	0.0122	0.008	56.4	2.0	-5.8	
1605	0.30	1.8	6.60	0.65		0.59	0.0123	0.009	52.4	1.3	-3.4	
1606												NO DATA
1607	0.30	2.1	0.0	-0.02			0.0092	-0.006	-2.4			
1608	0.30	1.8	9.70	0.94		0.86	0.0137	0.014	68.5	4.4	-0.4	
1609	0.30	1.9	13.50	1.20		1.01	0.0368	0.017	32.7	3.1	-1.7	

CONFIGURATION - 6, SC1095 AIRFOIL WITH ICE NO.1

RUN	MACH	RN	ALPH	CLP	CLPL	CL40	CDW	CMP	L/D	TOT T	STA T	REMARKS
1610	0.30	1.8	0.0	0.05		0.09	0.0111	0.001	5.0	10.5	5.6	
1611	0.30	2.0	6.60	0.74		0.75	0.0137	0.002	53.8	13.7	8.8	
1612	0.30	1.8	0.0	0.06		0.09	0.0119	0.007	5.1	10.6	5.7	
1613	0.30	2.1	9.90	0.94		0.94	0.0259	0.017	36.3	8.7	3.8	
1614	0.30	2.0	12.00	0.99		0.96	0.0573	-0.008	17.4	7.4	2.5	
1615	0.30	2.0	13.00	1.01		1.05	0.0948	-0.033	10.7	5.0	-0.1	
1616	0.30	2.0	14.00	1.05		1.12	0.1136	-0.048	9.2	3.9	-1.1	
1617	0.30	2.0	15.00	1.05		1.17	0.1555	-0.058	6.7	3.5	-1.5	
1618	0.31	1.9	16.00	1.00		1.21	0.1784	-0.064	5.6	3.7	-1.4	
1619	0.38	2.2	6.60	0.74		0.73	0.0128	-0.002	57.6	6.1	-1.9	
1620	0.39	2.5	9.90	0.96		0.92	0.0246	0.009	39.1	2.5	-5.8	
1621	0.39	2.5	12.00	0.97		0.94	0.0721	-0.013	13.4	1.2	-6.9	
1622	0.50	3.2	9.90	0.98	1.04	0.89	0.0287	0.007	34.2	1.6	-11.5	
1623	0.50	3.3	6.60	0.78	0.86	0.75	0.0138	-0.001	57.0	-1.2	-14.1	
1624	0.50	3.2	3.30	0.44	0.37	0.43	0.0113	-0.009	38.5	-0.6	-13.5	

APPENDIX B (CONT)

CONFIGURATION - 6, SC1095 AIRFOIL WITH ICE NO.1

RUN	MACH	RN	ALPH	CLP	CLPL	CL40	CDW	CMP	L/D	TOT T	STA T	REMARKS
1625	0.50	3.3	0.0	0.09	-0.02	0.08	0.0119	-0.008	7.3	-3.3	-16.0	
1626	0.58	3.5	0.0	0.10	0.07	0.10	0.0119	-0.013	8.2	-2.8	-19.5	
1627	0.58	3.6	3.30	0.47	0.49	0.46	0.0114	-0.011	40.9	-6.1	-22.7	
1628	0.58	3.5	6.60	0.82	0.85	0.76	0.0179	0.0	46.1	-6.5	-23.1	
1629	0.69	4.3	6.60	0.80	0.91	0.91	0.0576	-0.028	13.9	-7.1	-30.1	

CONFIGURATION - 11, VR-7 AIRFOIL WITH NO ICE

RUN	MACH	RN	ALPH	CLP	CLPL	CL40	CDW	CMP	L/D	TOT T	STA T	REMARKS
1630	0.69	3.9	0.15		0.29		0.0073		39.2	14.8	-10.2	
1631	0.69	4.1	3.40		0.76		0.0185		40.9	8.3	-16.1	
1632	0.73	4.5	0.15		0.33		0.0125		26.7	7.3	-19.8	
1633	0.78	4.6	0.15		0.37		0.0258		14.1	2.7	-27.3	
1634	0.58	3.7	0.15		0.14		0.0076		18.3	-0.0	-17.1	
1635	0.58	3.7	-2.00		0.08		0.0099		7.7	0.5	-16.6	
1636	0.58	3.7	3.40		0.74		0.0070		105.3	-0.8	-17.9	
1637	0.58	3.9	6.70		1.19		0.0103		115.2	-1.3	-18.6	
1638	0.59	4.0	10.00		1.43		0.0569		25.2	-1.8	-19.2	
1639	0.49	3.4	10.00		1.66		0.0166		100.1	0.1	-12.4	
1640	0.49	3.3	3.40		0.66		0.0070		94.6	-1.8	-14.0	
1641	0.49	3.4	0.15		0.43		0.0074		58.6	-1.4	-13.6	
1642	0.49	3.4	6.70		1.27		0.0095		133.9	-2.4	-14.6	
1643	0.39	2.8	6.70		1.00		0.0095		105.4	-0.9	-8.9	
1644	0.30	2.5	6.70				0.0095			1.1	-3.7	
1645	0.30	2.2	6.70		1.02		0.0091		112.6	-0.9	-5.7	
1646	0.30	2.3	10.00		1.74		0.0146		119.3	-0.7	-5.5	
1647	0.30	2.1	12.00		1.74		0.0316		55.2	10.0	5.0	
1648	0.30	2.1	3.40		0.03		0.0063			4.8	5.5	0.7
1649	0.30	2.2	0.15		-0.19		0.0085		-22.7	3.1	-1.7	

CONFIGURATION - 4, NACA 0012 AIRFOIL WITH ICE NO.3

RUN	MACH	RN	ALPH	CLP	CLPL	CL40	CDW	CMP	L/D	TOT T	STA T	REMARKS
1650	0.50	3.2	3.30	0.25	0.39	0.33	0.0283	-0.028	8.9	8.5	-4.8	
1651	0.50	3.2	3.30	0.26	0.46	0.33	0.0279	-0.024	9.2	-1.2	-14.0	
1652	0.57	3.2	0.0	0.01	-0.11	0.03	0.0282	-0.017	0.4	-2.9	-19.6	
1653	0.58	3.1	6.60	0.64	0.65	0.64	0.0301	0.003	21.2	-6.7	-23.3	
1654	0.57	3.4	3.30	0.31		0.36	0.0272	-0.013	11.5	-8.6	-24.9	
1655	0.68	4.4	3.30	0.38		0.39	0.0284	-0.009	13.5	-10.1	-32.5	
1656												CHECK RUN
1657	0.57	3.7	3.30	0.30			0.0320	-0.011	9.4			
1658	0.57	3.7	3.30	0.29		0.34	0.0320	-0.011	9.2	-5.7	-22.1	

CONFIGURATION - 10, SSC-A09 AIRFOIL WITH ICE NO.2

RUN	MACH	RN	ALPH	CLP	CLPL	CL40	CDW	CMP	L/D	TOT T	STA T	REMARKS
1659												CHECK RUN
1660	0.58	3.3	0.40	0.13	0.20		0.0378	-0.027	3.3	6.7	-10.8	
1661	0.58	3.4	3.70	0.48	0.51		0.0334	-0.026	14.3	2.3	-14.8	
1662	0.58	3.5	6.80	0.73	0.74		0.0471	-0.014	15.5	-1.0	-18.1	

APPENDIX B (CONT)

CONFIGURATION - 9, SSC-A09 AIRFOIL WITH ICE NO.1

RUN	MACH	RN	ALPH	CLP	CLPL	CL40	CDW	CMP	L/D	TOT T	STA T	REMARKS
1663	0.58	3.2	9.90	0.77	0.98		0.1035	-0.055	7.5	3.2	-14.4	
1664	0.69	3.9	6.80	0.74	0.83		0.0455	-0.017	16.2	-2.7	-26.0	
1665	0.68	3.9	3.70	0.53	0.58		0.0309	-0.023	17.2	-6.0	-28.8	
1666	0.68	3.9	0.40	0.12	0.08		0.0393	-0.028	3.1	-7.4	-30.0	
1667	0.73	4.3	0.40	0.13	0.15		0.0400	-0.029	3.3	-9.4	-34.6	
1668	0.58	3.4	8.50	0.76	0.88		0.0766	-0.020	10.0	-6.4	-23.1	
1669	0.58	3.7	6.80	0.73	0.87		0.0469	-0.010	15.5	-8.3	-24.8	
1670	0.49	2.7	6.80	0.70	0.66		0.0448	-0.013	15.7	2.7	-10.2	
1671	0.50	3.4	6.80	0.71	0.77		0.0471	-0.011	15.1	-3.6	-16.4	
1672	0.50	3.5	9.90	0.77	1.00		0.1033	-0.037	7.4	-6.3	-19.1	
1673	0.51	3.3	11.00	0.77	0.98		0.1255	-0.061	6.1	-7.8	-20.7	
1674	0.50	3.3	3.70	0.44	0.35		0.0327	-0.021	13.5	-9.9	-22.4	
1675	0.50	3.3	0.40	0.11	0.18		0.0374	-0.022	3.1	-9.6	-22.1	
1676	0.39	2.7	6.80	0.69			0.0458	-0.015	15.0	-9.3	-16.9	
1677	0.30	2.0	6.80	0.70			0.0455	-0.012	15.4	-7.7	-12.4	
1678	0.30	2.0	9.90	0.84			0.0997	-0.029	8.4	-8.8	-13.4	
1679	0.30	2.1	11.00	0.92			0.1427	-0.063	6.4	-8.2	-12.9	
1680	0.30	2.0	12.10	0.86			0.1530	-0.082	5.6	-7.7	-12.4	
1681	0.30	2.0	0.40	0.11			0.0369	-0.021	2.9	-8.3	-12.9	

CONFIGURATION - 7, SC1095 AIRFOIL WITH ICE NO.2

RUN	MACH	RN	ALPH	CLP	CLPL	CL40	CDW	CMP	L/D	TOT T	STA T	REMARKS
1682	0.35	1.6	6.60		0.78	0.70	0.0170			13.3	6.5	
1683	0.39	2.6	6.60		0.79	0.73	0.0168			5.5	-2.7	
1684	0.39	2.3	6.60	0.71	0.78	0.69	0.0162	-0.013	43.9	10.1	1.8	
1685	0.29	1.7	6.60	0.70	0.75	0.69	0.0162	-0.013	43.2	7.7	2.9	
1686	0.30	2.1	9.90	0.96	0.98	0.88	0.0372	-0.008	25.7	3.7	-1.1	
1687	0.30	2.0	12.00	0.99	0.98	1.01	0.0880	-0.048	11.2	1.0	-4.0	
1688	0.30	2.0	13.00	1.01	1.03	1.11	0.1045	-0.071	9.7	-1.3	-6.1	
1689	0.30	1.9	3.30	0.44	0.42	0.41	0.0093	-0.010	47.1	-2.5	-7.2	
1690	0.30	2.0	0.0	0.16	0.04	0.13	0.0102	-0.011	16.1	-3.5	-8.2	
1691	0.50	3.2	0.0	0.14	0.07	0.09	0.0112	-0.004	12.3	-4.3	-16.9	
1692	0.49	3.1	3.30	0.45	0.49	0.44	0.0103	-0.011	43.9	-7.3	-19.6	
1693	0.50	3.2	6.60	0.73	0.85	0.72	0.0178	-0.011	41.0	-7.5	-20.1	
1694	0.50	3.2	9.90	0.87	1.01	0.79	0.0553	-0.012	15.7	-9.7	-22.2	
1695	0.58	3.6	9.90	0.86	0.97	0.87	0.0761	-0.050	11.3	-8.9	-25.5	
1696	0.57	3.5	6.60	0.78	0.92	0.75	0.0193	-0.008	40.3	-10.2	-26.4	
1697	0.57	3.5	3.30	0.47	0.52	0.46	0.0111	-0.013	42.3	-11.1	-27.3	
1698	0.57	3.7	0.0	0.13	0.07	0.10	0.0118	-0.007	11.5	-11.2	-27.4	
1699	0.57	3.7	-2.00	-0.15	-0.20	-0.15	0.0103	-0.011	-14.6	-11.9	-28.1	
1700	0.58	3.7	4.00	0.59	0.61	0.54	0.0123	-0.005	47.8	-11.9	-28.1	
1701	0.58	3.7	8.00	0.93	0.95	0.84	0.0511	0.003	18.2	-12.4	-28.8	
1702	0.69	4.1	6.60	0.83	0.84	0.85	0.0509	-0.013	16.4	-4.4	-27.6	
1703	0.69	4.1	3.30	0.57	0.58	0.47	0.0167	-0.005	33.9	-9.2	-31.8	

CONFIGURATION - 10, SSC-A09 AIRFOIL WITH ICE NO.2

RUN	MACH	RN	ALPH	CLP	CLPL	CL40	CDW	CMP	L/D	TOT T	STA T	REMARKS
1704												
1705	0.72	3.8	0.40	0.18	0.15	0.23	0.0276	-0.014	6.6	9.4	-17.4	NO DATA
1706	0.73	4.2	0.40	0.18	0.15	0.24	0.0276	-0.013	6.5	-0.8	-26.8	

APPENDIX B (CONT)

CONFIGURATION - 10, SSC-A09 AIRFOIL WITH ICE NO.2

RUN	MACH	RN	ALPH	CLP	CLPL	CL40	CDW	CMP	L/D	TOT T	STA T	REMARKS
1707	0.68	3.8	0.40	0.18	0.14	0.22	0.0287	-0.012	6.1	1.1	-22.1	
1708	0.68	3.9	3.70	0.54	0.59	0.46	0.0347	-0.001	15.5	-4.0	-27.0	
1709	0.69	4.0	6.80	0.67	0.71	0.70	0.0890	-0.045	7.6	-8.2	-31.0	
1710	0.58	3.7	6.80	0.69	0.76	0.70	0.0796	-0.026	8.6	-7.6	-24.2	
1711	0.58	3.5	9.90	0.66	0.72	0.71	0.1389	-0.082	4.8	-6.3	-23.3	
1712	0.58	3.6	3.70	0.49	0.55	0.44	0.0336	-0.001	14.4	-7.2	-23.8	
1713	0.57	3.4	0.40	0.14	0.12	0.20	0.0290	-0.012	4.9	-11.0	-27.0	
1714	0.50	3.4	0.40	0.12	0.11	0.24	0.0292	-0.016	4.1	-5.4	-18.0	
1715												NO DATA
1716	0.50	3.1	3.70	0.47	0.51	0.48	0.0328	-0.005	14.2	10.1	-3.4	
1717	0.51	3.2	9.90	0.68	0.74	0.79	0.1365	-0.080	4.9	7.0	-6.7	
1718	0.51	3.3	11.00	0.65	0.72	0.74	0.1553	-0.089	4.2	4.3	-9.3	
1719	0.50	3.1	6.80	0.69	0.77	0.69	0.0713	-0.013	9.7	2.6	-10.5	
1720	0.39	2.7	6.80	0.73	0.75	0.82	0.0700	-0.021	10.4	3.5	-4.6	
1721	0.30	1.9	6.80	0.70	0.74	0.81	0.0604	-0.015	11.6	4.4	-0.4	
1722	0.30	2.0	9.90	0.75	0.76	1.05	0.1225	-0.100	6.1	3.2	-1.7	
1723	0.30	2.0	11.00	0.72	0.73	1.01	0.1475	-0.113	4.9	2.3	-2.6	
1724	0.31	2.1	12.10	0.70	0.73	0.98	0.1608	-0.116	4.4	1.4	-3.6	
1725	0.30	2.0	0.40	0.13	0.07	0.38	0.0240	-0.027	5.5	0.1	-4.5	

CONFIGURATION - 12, VR-7 AIRFOIL WITH ICE NO.1

RUN	MACH	RN	ALPH	CLP	CLPL	CL40	CDW	CMP	L/D	TOT T	STA T	REMARKS
1726												NO DATA
1727	0.30	1.8	0.15		0.18		0.0196		9.3	10.0	5.1	
1728	0.30	2.0	3.40		0.55		0.0141		39.1	5.9	1.1	
1729	0.30	2.0	6.70		0.90		0.0198		45.7	3.1	-1.7	
1730	0.30	2.1	10.00		1.14		0.0302		37.9	1.2	-3.6	
1731	0.30	2.1	12.00		1.16		0.0465		24.9	0.2	-4.7	
1732	0.38	2.3	6.70		0.94		0.0196		47.7	0.6	-7.3	
1733	0.49	2.7	6.70		1.01		0.0204		49.5	11.0	-1.9	
1734	0.50	3.3	6.70		1.00		0.0209		48.0	3.1	-10.0	
1735	0.50	3.3	10.00		1.14		0.0433		26.3	-0.8	-13.8	
1736	0.50	3.4	3.40		0.64		0.0159		40.4	-3.5	-16.4	
1737	0.50	3.4	0.15		0.23		0.0237		9.7	-6.1	-18.8	
1738	0.58	3.8	0.15		0.25		0.0243		10.3	-5.8	-22.5	
1739	0.57	3.8	-2.00		-0.07		0.0342		-2.0	-8.6	-25.0	
1740	0.58	3.8	3.40		0.69		0.0168		41.4	-10.4	-26.8	
1741	0.58	3.9	6.70		0.99		0.0198		50.2	-11.5	-27.9	
1742	0.58	4.1	10.00		1.04		0.0696		15.0	-11.7	-28.3	
1743	0.69	4.2	3.40		0.73		0.0238		30.6	-10.9	-33.6	
1744	0.68	4.3	0.15		0.29		0.0252		11.4	-12.7	-35.0	
1745	0.73	4.5	0.15		0.31		0.0301		10.5	-9.9	-35.2	
1746	0.58	3.3	8.50		1.06		0.0342		31.0	1.6	-15.8	
1747	0.58	3.9	0.0		0.23		0.0253		9.1	-4.8	-21.5	

CONFIGURATION - 21, OH-58 TAIL ROTOR WITH ICE NO.1

RUN	MACH	RN	ALPH	CLP	CLPL	CL40	CDW	CMP	L/D	TOT T	STA T	REMARKS
1748	0.57	2.8	-2.00		-0.33		0.0895		-3.7	4.8	-12.4	
1749	0.59	3.1	0.0		-0.03		0.0618		-0.4	-4.1	-21.4	
1750	0.58	2.9	0.0		-0.05		0.0678		-0.8	9.5	-8.1	

APPENDIX B (CONT)

CONFIGURATION - 21, OH-58 TAIL ROTOR WITH ICE NO.1

RUN	MACH	RN	ALPH	CLP	CLPL	CL40	COW	CMP	L/D	TOT T	STA T	REMARKS
1751	0.57	3.0	0.0		-0.05		0.0677		-0.8	-0.4	-17.2	
1752	0.58	3.1	3.30		0.40		0.1042		3.8	-7.0	-23.6	
1753	0.58	3.0	6.60		0.44		0.1515		2.9	-8.9	-25.6	
1754	0.68	3.0	0.0		-0.06		0.0705		-0.9	6.2	-17.5	
1755	0.50	2.8	0.0		-0.04		0.0686		-0.6	1.4	-11.7	
1756	0.39	2.3	6.60		0.49		0.1402		3.5	0.3	-7.8	
1757	0.40	2.3	6.60		0.50		0.1498		3.3	-2.5	-10.7	
1758	0.30	1.8	0.0		-0.06		0.0627		-1.0	0.3	-4.4	

CONFIGURATION - 20, OH-58 TAIL ROTOR WITH NO ICE

RUN	MACH	RN	ALPH	CLP	CLPL	CL40	COW	CMP	L/D	TOT T	STA T	REMARKS
1759	0.30	1.8	0.0		-0.05		0.0111		-4.6	1.8	-2.9	
1760	0.39	2.1	6.60		0.79		0.0129		61.2	-0.9	-8.8	
1761	0.50	2.9	0.0		-0.05		0.0116		-4.4	-3.0	-15.8	
1762	0.57	2.8	0.0		-0.06		0.0127		-4.6	-4.2	-20.8	
1763	0.57	3.0	-2.00		-0.34		0.0125		-27.3	-5.5	-22.0	
1764	0.57	3.0	3.30		0.49		0.0132		37.0	-6.5	-22.9	
1765	0.58	3.2	6.60		0.83		0.0344		25.7	-8.1	-24.6	
1766	0.68	3.5	0.0		-0.06		0.0143		-4.1	-9.2	-31.6	

CONFIGURATION - 25, NACA 0012 NT AIRFOIL WITH ICE NO.2

RUN	MACH	RN	ALPH	CLP	CLPL	CL40	COW	CMP	L/D	TOT T	STA T	REMARKS
1767	0.39	2.3	8.50		0.79		0.0270		29.3	15.2	6.8	

CONFIGURATION - 13, VR-7 AIRFOIL WITH ICE NO.2

RUN	MACH	RN	ALPH	CLP	CLPL	CL40	COW	CMP	L/D	TOT T	STA T	REMARKS
1768	0.30	2.0	0.15		0.17		0.0264		6.4	11.8	6.8	
1769	0.30	2.1	3.40		0.56		0.0232		24.0	9.8	4.9	
1770	0.30	2.1	6.70		0.88		0.0322		27.3	7.7	2.7	
1771	0.30	2.1	10.00		1.12		0.0534		20.9	6.2	1.2	
1772	0.30	2.1	12.00		1.11		0.0366		12.8	5.2	0.2	
1773	0.39	2.5	6.70		0.93		0.0346		27.0	9.3	1.1	
1774	0.39	2.6	3.40		0.59		0.0257		23.0	5.3	-2.8	
1775	0.50	3.3	3.40		0.64		0.0285		22.5	4.2	-9.0	
1776	0.50	3.3	6.70		1.00		0.0583		26.1	1.4	-11.8	
1777	0.51	3.3	10.00		1.10		0.0602		18.4	-0.2	-13.5	
1778	0.50	2.8	0.15		0.22		0.0298		7.3	15.3	1.8	
1779	0.58	3.4	0.15		0.24		0.0327		7.4	9.8	-7.8	
1780	0.58	3.7	3.40		0.70		0.0287		24.3	5.6	-11.9	
1781	0.58	3.7	6.70		1.02		0.0342		30.0	2.7	-14.7	
1782	0.69	4.2	3.40		0.75		0.0338		22.2	2.3	-21.6	
1783	0.69	4.2	0.15		0.27		0.0331		8.2	0.2	-23.4	
1784	0.73	4.2	0.15		0.30		0.0360		8.4	-0.9	-27.1	
1785	0.57	4.6	3.40		0.69		0.0294		23.3	-0.3	-17.2	
1786	0.84	3.5	3.40		0.44		0.0540		8.1	-3.5	-37.0	
1787	0.77	3.3	3.40		0.62		0.0506		12.2	-8.4	-36.4	
1788	0.67	2.8	3.40		0.77		0.0271		28.6	-9.4	-30.9	

APPENDIX B (CONT)

CONFIGURATION - 13, VR-7 AIRFOIL WITH ICE NO.2

RUN	MACH	RN	ALPH	CLP	CLPL	CL40	CDW	CMP	L/D	TOT T	STA T	REMARKS
1789	0.57	2.4	3.40		0.71		0.0262		27.3	-12.0	-27.8	
1790	0.48	2.1	3.40		0.66		0.0262		25.2	-13.0	-24.4	

CONFIGURATION - 17, SC1012 R8 AIRFOIL WITH NO ICE

RUN	MACH	RN	ALPH	CLP	CLPL	CL40	CDW	CMP	L/D	TOT T	STA T	REMARKS
1791	0.30	2.0	0.0	0.09	0.09	0.12	0.0081	-0.026	11.0	14.2	9.2	
1792	0.30	2.0	0.0	0.10	0.09	0.13	0.0079	-0.029	12.4	8.9	4.0	
1793	0.30	2.1	3.30	0.47	0.46	0.49	0.0077	-0.030	61.3	6.0	1.2	
1794	0.30	2.1	6.60	0.82	0.81	0.80	0.0084	-0.028	98.7	4.0	-0.8	
1795	0.30	2.1	9.90	1.17	1.17	1.10	0.0111	-0.022	105.6	2.6	-2.2	
1796	0.38	2.1	9.90	1.17	1.19	1.10	0.0115	-0.019	102.3	2.1	-5.6	
1797	0.39	2.7	9.90	1.21	1.21	1.14	0.0116	-0.023	104.2	0.4	-7.7	
1798	0.39	2.5	6.60	0.86	0.84	0.85	0.0086	-0.030	99.2	14.2	5.8	
1799	0.39	2.6	6.60	0.86	0.85	0.85	0.0086	-0.030	100.4	7.4	-0.8	
1800	0.39	2.6	3.30	0.49	0.47	0.51	0.0077	-0.032	63.2	4.5	-3.6	
1801	0.39	2.5	0.0	0.10	0.07	0.15	0.0082	-0.030	12.5	5.1	-3.0	

CONFIGURATION - 18, SC1012 R8 AIRFOIL WITH ICE NO.1

RUN	MACH	RN	ALPH	CLP	CLPL	CL40	CDW	CMP	L/D	TOT T	STA T	REMARKS
1802	0.30	2.3	0.0	0.14	0.13	0.21	0.0147	-0.036	9.8	13.7	8.7	
1803	0.30	2.1	3.30	0.41	0.42	0.45	0.0189	-0.024	21.8	9.8	4.9	
1804	0.30	2.1	6.60	0.70	0.71	0.71	0.0253	-0.019	27.6	5.4	0.5	
1805	0.30	2.1	9.90	0.88	0.91	0.82	0.0547	-0.015	16.2	3.0	-1.9	
1806	0.30	1.9	0.0	0.06	0.05	0.12	0.0181	-0.021	3.1	14.4	9.4	
1807	0.30	2.0	0.0	0.09	0.07	0.15	0.0179	-0.031	5.1	9.5	4.6	

CONFIGURATION - 19, SC1012 R8 AIRFOIL WITH ICE NO.2

RUN	MACH	RN	ALPH	CLP	CLPL	CL40	CDW	CMP	L/D	TOT T	STA T	REMARKS
1808	0.39	2.4	0.0	0.09	0.06	0.28	0.0416	-0.041	2.3	13.6	5.1	
1809	0.39	2.4	3.30	0.43	0.43	0.50	0.0233	-0.030	18.3	10.7	2.3	
1810	0.39	2.6	6.60	0.75	0.77	0.75	0.0309	-0.015	24.2	8.4	0.2	
1811	0.39	2.6	9.90	0.91	0.96	0.80	0.0587	-0.008	15.4	5.3	-2.9	

CONFIGURATION - 14, SC1094 R8 AIRFOIL WITH NO ICE

RUN	MACH	RN	ALPH	CLP	CLPL	CL40	CDW	CMP	L/D	TOT T	STA T	REMARKS
1812	0.39	2.4	9.90	1.13	1.14	1.08	0.0119	-0.019	94.9	13.1	4.6	
1813	0.39	2.6	9.90	1.14	1.17	1.09	0.0122	-0.014	93.8	9.2	1.0	
1814	0.39	2.5	6.60	0.82	0.82	0.79	0.0090	-0.020	91.2	4.8	-3.2	
1815	0.39	2.7	3.30	0.46	0.45	0.44	0.0073	-0.015	63.1	2.9	-5.1	
1816	0.38	2.7	0.0	0.09	0.04	0.08	0.0071	-0.010	12.6	1.2	-6.7	
1817	0.50	3.1	0.0	0.11	0.05	0.11	0.0070	-0.016	15.3	-0.0	-12.9	
1818	0.50	3.3	3.30	0.48	0.49	0.47	0.0080	-0.017	60.4	-1.0	-13.8	
1819	0.50	3.2	6.60	0.84	0.88	0.79	0.0106	-0.012	79.0	-3.4	-16.2	
1820	0.50	3.2	9.90	1.10	1.18	0.98	0.0340	0.0	32.3	-4.5	-17.2	

APPENDIX B (CONT)

CONFIGURATION - 14, SC1094 R8 AIRFOIL WITH NO ICE

RUN	MACH	RN	ALPH	CLP	CLPL	CL40	CDW	CMP	L/D	TOT T	STA T	REMARKS
1821	0.30	2.1	9.90	1.10	1.11	1.05	0.0110	-0.018	99.9	-2.8	-7.5	
1822	0.30	2.1	6.60	0.79	0.77	0.75	0.0087	-0.018	90.5	0.4	-4.3	
1823	0.30	2.0	3.30	0.42	0.41	0.40	0.0071	-0.008	58.5	-1.0	-5.8	
1824	0.30	2.0	0.0	0.07	0.02	0.06	0.0070	-0.007	9.6	-2.2	-6.8	

CONFIGURATION - 15, SC1094 R8 AIRFOIL WITH ICE NO.1

RUN	MACH	RN	ALPH	CLP	CLPL	CL40	CDW	CMP	L/D	TOT T	STA T	REMARKS
1825	0.30	2.0	0.0		0.05	-0.03	0.0181		2.8	13.8	8.7	
1826	0.30	2.0	3.30		0.40	0.20	0.0269		14.9	11.0	6.1	
1827	0.30	2.0	6.60		0.68	0.81	0.0809		8.4	7.0	2.1	
1828	0.30	2.2	9.90		0.73	0.84	0.1460		5.0	5.1	0.1	

CONFIGURATION - 16, SC1094 R8 AIRFOIL WITH ICE NO.2

RUN	MACH	RN	ALPH	CLP	CLPL	CL40	CDW	CMP	L/D	TOT T	STA T	REMARKS
1829												CHECK RUN
1830	0.50	3.2	0.0	-0.02	-0.02	-0.16	0.0757	-0.001	-0.2	12.2	-1.4	
1831	0.50	3.2	3.30	0.34	0.40	0.40	0.0665	-0.011	5.1	7.5	-5.8	
1832	0.50	3.2	6.60	0.58	0.67	0.67	0.0946	-0.021	6.2	4.2	-9.0	
1833	0.51	3.3	9.90	0.56	0.62	0.73	0.1600	-0.084	3.5	3.5	-10.1	

APPENDIX C
 Run Log and Tabulated Test Data
 NRC Phase II Test

Description of Run Log/Data Headings

MACH	Free stream Mach number
RN	Model Reynolds number
ALPH	Model angle of attack, degrees
CLP	Lift coefficient calculated from integrated airfoil surface pressures
CLPL	Lift coefficient calculated from ceiling and floor static pressures
CL40	Lift coefficient calculated from airfoil static pressures at X/C of 40%
CDW	Drag coefficient calculated from wake momentum depression integration
CMP	Quarter chord pitching moment coefficient calculated from integrated airfoil surface pressures
L/D	Lift-drag ratio, CLP/CDW when CLP is available, otherwise CLPL/CDW
TOT T	Free stream total temperature, °C
STA T	Free stream static temperature, °C
LWC	Liquid water content, g/m ³
TIME	Icing time, seconds
DIA	Mean volume droplet diameter, microns
FREQ	Airfoil oscillation frequency, Hz
AMP	Airfoil oscillation amplitude (peak-to-peak), degrees
LENGTH	Length of upper surface ice growth from airfoil surface to tip of rime growth or to tip of upper horn
WIDTH	Distance between tips of upper and lower horns
TIME INC	Time between end of ice accretion and the acquisition of aerodynamic data

APPENDIX C (CONT)

CONFIGURATION - 7, OH-58 TAIL ROTOR

RUN	MACH	RN	ALPH	CLP	CLPL	CL40	CDW	CMP	L/D	TOT T	STA T	LWC TIME	DIA FREQ	AMP	THICK SPAN	REMARKS
1834 TO 1864 INSTRUMENTATION CHECK RUNS																
1865	0.38	1.0	-0.07	-0.04	0.0146				-2.6	27.2	19.1					
1866	0.38	1.0	2.99	0.26	0.0150				17.3	27.2	19.0					
1867	0.38	1.0	5.99	0.62	0.0166				37.6	27.2	19.0					
1868	0.38	1.0	8.99	0.94	0.0245				38.2	27.2	19.0					
1869	0.37	1.2	0.04	-0.02	0.0154				-1.1	-10.0	-17.0					FAIRED
1870	0.37	1.2	3.01	0.30	0.0148				20.0	-10.0	-17.1					AEROSION
1871	0.37	1.2	5.98	0.64	0.0170				37.6	-10.0	-16.9					STRIP
1872	0.37	1.2	8.99	0.95	0.0265				35.9	-10.0	-17.0					
1873	0.56	1.7	6.13	0.83					-10.0	-25.5						
1874	0.56	1.7	6.13	0.81					-10.0	-25.5	0.35	45.	20.	0.0	0.	0.22 0.25
1875	0.37	1.2	6.00	0.69	0.0171				40.1	-10.0	-17.1					
1876	0.56	1.7	6.00	0.80	0.0429				18.6	-10.0	-25.6					
1877	0.56	1.7	5.95	0.78	0.0440				17.8	-10.0	-25.6	0.35	45.	20.	0.0	0.22 0.25
1878	0.59	1.6	5.54	0.77	0.0422				18.2	-10.0	-26.9					
1879	0.59	1.8	5.54	0.75	0.0440				17.1	-10.0	-26.9	0.59	45.	20.	0.0	0.25 0.31

CONFIGURATION - 1, NACA 0012 AIRFOIL

RUN	MACH	RN	ALPH	CLP	CLPL	CL40	CDW	CMP	L/D	TOT T	STA T	LWC TIME	DIA FREQ	AMP	THICK SPAN	REMARKS
1880	0.38	1.4	0.06	-0.05	-0.07	-0.01	0.0077	0.002	-6.3	-10.0	-17.6					
1881	0.39	1.4	6.06	0.69	0.68	0.75	0.0104	-0.006	66.2	-10.0	-17.6					
1882	0.58	2.0	0.02	-0.07	-0.08	-0.02	0.0088	0.001	-8.0	-10.0	-26.8					
1883	0.59	2.0	0.01	-0.06	-0.06	-0.02	0.0197	0.003	-3.3	-10.0	-26.9	0.38	45.	20.	0.0	0.16 0.28

CONFIGURATION - 10, SSC-A09 AIRFOIL WITH ICE NO. 2

RUN	MACH	RN	ALPH	CLP	CLPL	CL40	CDW	CMP	L/D	TOT T	STA T	LWC TIME	DIA FREQ	AMP	THICK SPAN	REMARKS
1884	0.59	2.0	0.02	0.10	0.04	0.11	0.0366					2.7	-7.2	-24.3		
1885	0.59	2.0	0.02	0.09	0.03	0.18	0.0378	-0.019	2.5	-7.2	-24.3					
1886	0.59	2.0	3.01	0.46	0.49	0.51	0.0376	-0.022	12.3	-7.2	-24.4					
1887	0.59	2.0	6.02	0.83	0.87	0.92	0.0732	-0.024	11.6	-7.2	-24.4					
1888	0.49	1.7	6.01	0.79	0.82	0.88	0.0906	-0.019	10.7	-7.2	-19.4					
1889	0.39	1.4	6.01	0.75	0.79	0.79	0.0733	-0.012	10.4	-7.2	-14.9					
1890	0.29	1.1	6.01	0.70	0.75	0.69	0.0726	-0.009	9.9	-7.2	-11.8					
1891	0.30	1.1	9.02	0.93	0.92	1.30	0.0391	-0.093	10.6	-7.2	-11.8					
1892	0.30	1.1	11.02	0.90	0.92	1.20	0.1451	-0.124	9.0	-7.2	-11.8					
1893	0.29	1.1	0.03	0.10	-0.03	0.16	0.0362	-0.011	2.7	-7.2	-11.8					
1894	0.49	1.7	0.03	0.11	0.03	0.17	0.0363	-0.011	3.0	-7.2	-19.2					
1895	0.49	1.7	3.04	0.47	0.47	0.46	0.0370	-0.007	12.8	-7.2	-19.2					
1896	0.49	1.7	3.03	0.48	0.44	0.46	0.0370	-0.008	12.8	-7.2	-19.2					
1897	0.69	2.2	3.05	0.56	0.58	0.57	0.0383	-0.015	14.7	-7.2	-30.3					
1898	0.66	2.1	6.01	0.85	0.96	0.90	0.0636	-0.028	12.3	-7.2	-28.1					
1899	0.69	2.2	0.03	0.12	0.05	0.20	0.0372	-0.015	3.3	-7.2	-30.2					
1900	0.75	2.3	0.05	0.14	0.08	0.25	0.0352	-0.019	3.9	-7.2	-34.2					

APPENDIX C (CONT)

CONFIGURATION - 10, SSC-A09 AIRFOIL WITH ICE NO. 2

RUN	MACH	RN	ALPH	CLP	CLPL	CL40	CDW	CMP	L/D	TOT T	STA T	LWC TIME	DIA FREQ AMP	THICK SPAN	REMARKS
1901	0.58	2.0	9.03	0.93	0.94	1.25	0.1068	-0.101	9.9	-7.2	-23.8				
1902	0.49	1.7	9.04	0.90	0.92	1.24	0.1028	-0.102	8.7	-7.2	-19.3				
1903	0.29	1.1	8.99	0.91	0.93	1.33	0.1367	-0.100	6.6	-7.2	-11.7				
1904	0.30	1.1	10.99	0.88	0.94	1.20	0.1714	-0.131	5.1	-7.2	-11.7				
1905	0.49	1.7	9.05	0.90	0.95	1.24	0.1397	-0.106	6.5	-7.2	-19.3				
1906	0.59	2.0	5.98	0.80	0.90	0.94	0.0775	-0.035	10.4	-7.2	-24.3				
1907	0.59	2.0	5.97	0.80	0.90	0.94	0.0781	-0.035	10.3	-7.2	-24.3				
1908	0.58	2.0	8.99	0.94	0.94	1.26	0.1312	-0.106	7.2	-7.2	-23.7				
1909	0.49	1.7	6.00	0.78	0.86	0.95	0.0825	-0.031	9.5	-7.2	-19.1				

CONFIGURATION - 9, NACA 0012 AIRFOIL WITH ICE NO. 2A

RUN	MACH	RN	ALPH	CLP	CLPL	CL40	CDW	CMP	L/D	TOT T	STA T	LWC TIME	DIA FREQ AMP	THICK SPAN	REMARKS
1910	0.39	1.4	0.09	0.0	-0.04	-0.17		-0.028				-5.0	-12.9		
1911	0.39	1.4	0.10	0.00	-0.03	-0.08		-0.028				-5.0	-12.8		
1912	0.39	1.4	0.01	-0.03	-0.08	-0.10	0.0180	-0.015	-1.5			-5.0	-12.8		
1913	0.39	1.4	2.99	0.29	0.30	0.26	0.0215	-0.020	13.3			-5.0	-12.9		
1914	0.39	1.4	6.00	0.56	0.66	0.58	0.0291	-0.008	19.1			-5.0	-12.9		
1915	0.39	1.4	9.01	0.80	0.96	0.76	0.0618	-0.005	13.0			-5.0	-12.9		
1916	0.39	1.4	12.00	0.89	1.04	1.13	0.1166	-0.110	7.6			-5.0	-13.0		
1917	0.39	1.4	12.00	0.96	1.03	1.13	0.1502	-0.070	6.4			-5.0	-12.9		
1918	0.30	1.1	0.0	-0.03	0.00	-0.06	0.0186	0.001	-1.6			-5.0	-9.8		
1919	0.30	1.1	3.03	0.24	0.30	0.24	0.0205	-0.004	11.8			-5.0	-9.7		
1920	0.30	1.1	5.99	0.50	0.58	0.56	0.0272	-0.008	18.4			-5.0	-9.8		
1921	0.30	1.1	9.01	0.76	0.94	0.74	0.0517	-0.006	14.7			-5.0	-9.7		
1922	0.30	1.1	12.01	0.82	1.05	1.08	0.1466	-0.079	5.7			-5.0	-9.6		
1923	0.49	1.7	0.03	-0.03	-0.08	-0.08	0.0169	-0.005	-1.8			-5.0	-17.1		
1924	0.49	1.7	3.02	0.29	0.36	0.30	0.0221	-0.007	12.9			-5.0	-17.3		
1925	0.49	1.7	6.00	0.61	0.73	0.63	0.0320	-0.002	19.1			-6.9	-20.9		
1926	0.49	1.7	8.99	0.78	0.93	0.79	0.0885	-0.021	6.9			-8.9	-21.0		
1927	0.59	2.0	0.01	-0.04	-0.04	-0.07	0.0191	-0.006	-2.2			-8.9	-25.9		
1928	0.59	2.0	3.02	0.32	0.40	0.34	0.0227	-0.008	14.2			-8.9	-25.9		
1929	0.59	2.0	6.03	0.68	0.83	0.67	0.0350	-0.005	19.5			-8.9	-26.0		
1930	0.69	2.2	0.05	-0.04	-0.02	-0.07	0.0204	-0.008	-2.1			-8.9	-31.9		
1931	0.38	1.4	0.03	-0.03	-0.03	-0.06	0.0177	-0.005	-1.7			-10.0	-17.5		
1932	0.38	1.4	0.03	-0.03	-0.05	-0.05	0.0166	-0.005	-1.6			-10.0	-17.6		
1933	0.38	1.4	3.01	0.26	0.31	0.27	0.0174	-0.008	14.8			-10.0	-17.5		
1934	0.39	1.4	6.01	0.57	0.67	0.60	0.0256	-0.009	22.5			-10.0	-17.6		
1935	0.39	1.4	9.01	0.81	0.96	0.75	0.0543	-0.004	14.7			-10.0	-17.7		
1936	0.39	1.4	-0.01	-0.03	-0.06	-0.06	0.0164	-0.006	-2.0			-10.0	-17.6		
1937	0.39	1.4	0.0	-0.04	-0.05	-0.09	0.0171	-0.005	-2.2			-10.0	-17.8		
1938	0.39	1.4	2.99	0.26	0.30	0.26	0.0203	-0.009	12.6			-10.0	-17.6		
1939	0.39	1.4	6.00	0.55	0.63	0.58	0.0260	-0.003	19.7			-10.0	-17.8		
1940	0.39	1.4	9.03	0.80	0.94	0.76	0.0558	-0.004	14.2			-10.0	-14.4		
1941	0.29	1.1	0.0	-0.12	-0.08	-0.06	-0.014	-0.014	-2.0			-10.0	-14.4		
1942	0.29	1.1	6.00	0.62	0.55		0.029	-0.029	-10.0			-10.0	-14.4		

APPENDIX C (CONT.)

CONSTRUCTION = 9, NACA 0012 AIRFOIL WITH ICE NO.2A

CONFIGURATION - 1, NACA 0012 AIRFOIL

RUN	MACH	RN	ALPH	CLP	CLPL	CL40	CDW	CMP	L/D	TOT T	STA T	LWC TIME	DIA TIME	INC	THICK SPAN	REMARKS
1946	0.38	1.4	5.92	0.73	0.77	0.69	0.0117	-0.001	62.3	-10.0	-17.6	0.48	60.	20.	0:20	SEE RUN 1950
1947	0.38	1.4	5.88	0.63	0.75	0.62	0.0381	0.002	16.4	-10.0	-17.6	0.48	60.	20.	0:20	SEE RUN 1950
1948	0.39	1.4	5.88	0.62	0.74	0.62	0.0299	-0.001	20.7	-10.0	-17.6	0.48	60.	20.	0:20	SEE RUN 1950
1949	0.39	1.4	5.87	0.63	0.73	0.62	0.0261	-0.002	24.0	-10.0	-17.7	0.48	60.	20.	0:20	SEE RUN 1950
1950	0.39	1.4	5.86	0.63	0.69	0.62	0.0261	-0.003	24.3	-10.0	-17.7	0.48	60.	20.	0:20	SEE RUN 1950
1951	0.39	1.4	5.86	0.63	0.94	0.62	0.0264	-0.003	24.0	-10.0	-17.6	0.48	60.	20.	0:20	SEE RUN 1950
1952	0.39	1.4	5.85	0.72	0.69	0.66	0.0114	-0.002	63.6	-10.0	-17.6	0.48	60.	20.	0:20	0.25 0.39 FROST, FEATH
1953	0.39	1.4	5.85	0.61	0.71	0.57	0.0443	0.004	13.7	-10.0	-17.7	0.48	60.	20.	0:20	0.25 0.39 FROST, FEATH
1954	0.39	1.4	5.85	0.63	0.68	0.59	0.0312	0.003	20.2	-10.0	-17.6	0.48	60.	20.	0:20	0.25 0.39 FROST, FEATH
1955	0.39	1.4	5.85	0.62	0.68	0.55	0.0413	0.003	15.0	-10.0	-17.7	0.48	60.	20.	0:20	0.25 0.39 FROST, FEATH
1956	0.39	1.4	0.03	0.05	-0.03	-0.01	0.0217	0.003	2.4	-10.0	-17.6	0.48	60.	20.	0:20	0.25 0.39 FROST, FEATH
1957	0.39	1.4	5.90	0.60	0.63	0.59	0.0292	-0.001	20.5	-10.0	-17.6	0.48	60.	20.	0:20	0.25 0.39 FROST, FEATH
1958	0.39	1.4	-0.01	0.05	0.00	-0.03	0.0193	0.003	2.5	-10.0	-17.7	0.48	60.	20.	0:20	0.25 0.39 FROST, FEATH
1959	0.39	1.4	5.92	0.61	0.66	0.61	0.0256	-0.004	23.7	-10.0	-17.7	0.48	60.	20.	0:20	0.25 0.39 FROST, FEATH
1960	0.39	1.4	5.84	0.71	0.69	0.66	0.0125	0.0	56.6	-10.0	-17.6	0.48	60.	20.	0:20	0.25 0.39 FROST, FEATH
1961	0.39	1.4	5.85	0.60	0.69	0.56	0.0420	0.001	14.2	-10.0	-17.6	0.48	60.	20.	0:20	0.25 0.39 FROST, FEATH
1962	0.39	1.4	5.84	0.59	0.66	0.60	0.0348	-0.006	16.8	-10.0	-17.7	0.48	60.	20.	0:20	0.25 0.39 FROST, FEATH
1963	0.38	1.4	5.84	0.60	0.67	0.60	0.0279	-0.006	21.5	-10.0	-17.6	0.48	60.	20.	0:20	0.25 0.39 FROST, FEATH

CONFIGURATION - 12, H-34 MODEL ROTOR BLADE

RUN	MACH	RN	ALPH	CLP	CLPL	CL40	CDW	CNP	L/D	TOT T	STA T	LWC TIME	DIA FREQ	AMP	THICK SPAN	REMARKS	
1964	0.29	0.5	0.01	0.03				0.0076		3.3	-10.0	-14.4					
1965	0.29	0.5	3.01	0.06				0.0102		6.1	-10.0	-14.4					
1966	0.29	0.5	5.98	0.38				0.0150		25.4	-10.0	-14.4					
1967	0.29	0.5	8.99	1.00				0.0245		40.8	-10.0	-14.4					
1968	0.29	0.5	11.02	0.87				0.1081		8.1	-10.0	-14.4					
1969	0.29	0.5	12.51	0.96				0.1948		4.9	-10.0	-14.4					
1970	0.29	0.5	14.00	0.79				0.1624		4.9	-10.0	-14.4					
1971	0.38	0.6	0.0	-0.03				0.0076		-3.7	-10.0	-17.5					
1972	0.38	0.6	3.00	0.19				0.0101		19.0	-10.0	-17.5					
1973	0.38	0.6	6.00	0.68				0.0156		43.5	-10.0	-17.4					
1974	0.38	0.6	9.00	1.01				0.0498		20.3	-10.0	-17.5					
1975	0.38	0.6	12.02	1.18				0.1364		8.7	-10.0	-17.5					
1976	0.48	0.8	0.01	-0.02				0.0073		-2.8	-10.0	-21.7					
1977	0.48	0.8	3.00	0.27				0.0116		23.1	-10.0	-21.8					
1978	0.48	0.8	6.02	0.66				0.0194		34.2	-10.0	-21.7					
1979	0.48	0.8	9.02	0.94				0.1156		8.1	-10.0	-21.8					

APPENDIX C (CONT)

CONFIGURATION - 12, H-34 MODEL ROTOR BLADE

RUN	MACH	RN	ALPH	CLP	CLPL	CL40	CDW	CMP	L/D	TOT T	STA T	LWC TIME	DIA FREQ	AMP	THICK SPAN	REMARKS
1980	0.48	0.8	12.02	1.22	0.1993	6.1	-10.0	-21.9								
1981	0.58	0.9	0.02	-0.01	0.0090	-1.4	-10.0	-26.7								
1982	0.58	0.9	2.99	0.15	0.0103	14.4	-10.0	-26.6								
1983	0.58	0.9	6.01	0.78	0.0351	22.2	-10.0	-26.8								
1984	0.58	0.9	9.00	0.33	0.1309	2.5	-10.0	-26.7								
1985	0.67	1.0	0.01	-0.03	0.0113	-2.4	-10.0	-31.8								
1986	0.66	1.0	3.02	0.36	0.0204	17.4	-10.0	-32.5								
1987	0.48	0.8	6.01	0.73	0.0178	40.9	-10.0	-21.6								
1988	0.48	0.8	6.02	0.54	0.1697	3.2	-10.0	-21.5	0.66	60.	20.	0.0	0.	0.33	0.36	
1989	0.48	0.8	6.07	0.70	0.0193	36.5	-10.0	-21.5								
1990	0.48	0.8	6.07	0.68	0.0772	8.8	-10.0	-21.6	0.66	45.	20.	0.0	0.	0.27	0.23	
1991	0.58	0.9	6.06	0.76	0.0330	23.0	-10.0	-26.5								
1992	0.58	0.9	6.06	0.83	0.0478	17.3	-10.0	-26.4	0.38	45.	20.	0.0	0.	0.23	0.14	
1993	0.57	0.9	6.05	0.74	0.0328	23.2	-10.0	-26.4								
1994	0.57	0.9	6.06	0.69	0.0689	10.0	-10.0	-26.4	0.62	45.	20.	0.0	0.	0.25	0.25	
1995	0.57	0.9	2.97	0.29	0.0118	24.9	-10.0	-26.4								
1996	0.58	0.9	2.98	0.30	0.0654	4.6	-10.0	-26.6	0.38	45.	20.	0.0	0.	0.23	0.23	
1997	0.29	0.5	6.01	0.64	0.0164	39.0	-10.0	-14.4								
1998	0.28	0.5	6.01	0.66	0.0737	8.9	-10.0	-14.3	0.66	60.	20.	0.0	0.	0.16	ROUND	
1999	0.29	0.5	6.00	0.59	0.0148	39.8	-10.0	-14.4								
2000	0.29	0.5	5.98	0.62	0.1434	4.3	-10.0	-14.4	1.00	60.	20.	0.0	0.	0.20	0.25	TIME INC 0:20
2001	0.29	0.5	5.98	0.53	0.1345	4.0	-10.0	-14.4								3:25
2002	0.29	0.5	8.98	1.10	0.0223	49.4	-10.0	-14.4								
2003	0.29	0.5	8.98	0.86	0.1675	5.1	-10.0	-14.4	0.66	60.	20.	0.0	0.	0.17	0.16	
2004	0.29	0.5	11.00	1.22	0.1543	7.9	-10.0	-14.4								
2005	0.29	0.5	10.98	1.20	0.1782	6.7	-10.0	-14.3	0.66	60.	20.	0.0	0.	0.16	0.13	
2006	0.29	0.5	5.98	0.83	0.0166	49.9	-10.0	-14.4								
2007	0.29	0.5	5.98	0.43	0.0725	5.9	-10.0	-14.2	0.40	60.	20.	0.0	0.	0.16	0.13	
2008	0.29	0.5	0.01	-0.04	0.0115	-3.3	-10.0	-14.4								
2009	0.29	0.5	0.02	-0.07	0.0462	-1.5	-10.0	-14.3	0.66	60.	20.	0.0	0.	0.16	0.20	
2010	0.58	0.9	0.04	-0.04	0.0105	-3.9	-10.0	-26.4								
2011	0.58	0.9	0.03	-0.05	0.0830	-0.6	-10.0	-26.5	0.38	45.	20.	0.0	0.	0.22	0.25	
2012	0.67	1.0	0.04	-0.06	0.0119	-5.2	-6.1	-28.4								
2013	0.66	1.0	0.04	-0.05	0.0835	-0.6	-6.1	-27.5	0.38	45.	20.	0.0	0.	0.28	0.22	
2014	0.67	1.0	0.01	-0.07	0.0120	-5.5	-10.0	-31.7								
2015	0.69	1.0	0.01	-0.07	0.0346	-2.1	-10.0	-32.6	0.38	45.	20.	0.0	0.	0.28	0.16	

1
W

CONFIGURATION - 11, NACA 0012 AIRFOIL WITH WOODEN ICE

RUN	MACH	RN	ALPH	CLP	CLPL	CL40	CDW	CMP	L/D	TOT T	STA T	LWC TIME	DIA FREQ	AMP	THICK SPAN	REMARKS
2016	0.35	1.3	0.0	-0.05	-0.05	-0.16	0.0146	0.001	-3.1	-10.0	-16.4					
2017	0.35	1.3	-0.01	-0.05	-0.05	-0.17	0.0145	0.001	-3.1	-10.0	-16.4					
2018	0.35	1.4	3.04	0.28	0.30	0.43	0.0189	-0.001	14.6	-10.0	-16.5					
2019	0.35	1.4	6.00	0.57	0.63	0.56	0.0374	0.011	15.3	-10.0	-16.5					
2020	0.35	1.4	9.03	0.76	0.82	0.94	0.0591	-0.031	8.1	-10.0	-16.5					
2021	0.29	1.1	6.05	0.57	0.61	-0.02	0.0365	0.018	13.4	-10.0	-14.6					
2022	0.38	1.4	0.01	-0.04	-0.04	-0.16	0.0154	0.004	-2.3	-10.0	-17.5					

APPENDIX C (CONT)

CONFIGURATION - 11, NACA 0012 AIRFOIL WITH WOODEN ICE

RUN	MACH	RN	ALPH	CLP	CLPL	CL40	CDW	CMP	L/D	TOT T	STA T	LWC TIME	DIA FREQ	AMP	THICK SPAN	REMARKS
2023	0.38	1.4	3.03	0.28	0.33	0.25	0.0195	0.005	14.5	-10.0	-17.6					
2024	0.38	1.4	6.00	0.59	0.65	0.54	0.0376	0.015	15.6	-10.0	-17.6					
2025	0.38	1.5	9.04	0.76	0.81	0.95	0.0987	-0.034	7.7	-10.0	-17.6					
2026	0.49	1.8	9.04	0.74	0.81	0.91	0.1010	-0.038	7.3	-10.0	-21.9					
2027	0.48	1.8	6.01	0.63	0.75	0.56	0.0471	0.016	13.4	-10.0	-21.9					
2028	0.48	1.8	3.02	0.37	0.38	1.06	0.0222	-0.025	16.9	-10.0	-21.9					
2029	0.48	1.8	0.01	-0.03	-0.02	-0.18	0.0158	0.004	-11.7	-10.0	-21.8					
2030	0.58	2.0	0.01	-0.04	-0.03	-0.20	0.0157	0.006	-2.3	-10.0	-26.6					
2031	0.58	2.0	3.02	0.33	0.39	0.26	0.0204	0.009	16.3	-10.0	-26.9					
2032	0.58	2.0	6.01	0.68	0.81	0.62	0.0497	0.020	13.6	-10.0	-26.8					
2033	0.68	2.3	0.04	-0.04	-0.02	-0.19	0.0162	0.007	-2.6	-10.0	-32.5					

HOT FILM ANEMOMETER TUNNEL TURBULENCE STUDY

RUN	MACH	RN	ALPH	CLP	CLPL	CL40	CDW	CMP	L/D	TOT T	STA T	LWC TIME	DIA FREQ	AMP	THICK SPAN	REMARKS
2034	0.29	1.0								20.0	15.1					TURBULENCE = 1.64%
2035	0.38	1.2								20.0	11.7					TURBULENCE = 1.59%
2036	0.48	1.5								20.0	7.1					TURBULENCE = 2.14%
2037	0.58	1.8								20.0	1.5					TURBULENCE = 1.85%

CONFIGURATION - 1, NACA 0012 AIRFOIL

RUN	MACH	RN	ALPH	CLP	CLPL	CL40	CDW	CMP	L/D	TOT T	STA T	LWC TIME	DIA TIME	INC	THICK SPAN	REMARKS
2038	0.38	1.5	6.02	0.73	0.76	0.72	0.0123	-0.003	59.2	-10.0	-17.5					
2039	0.38	1.5	6.02	0.66	0.73	0.58	0.0496	0.004	13.3	-10.0	-17.5	0.70	60.	20.	0:15	SEE RUN 2044
2040	0.38	1.5	6.02	0.66	0.72	0.58	0.0664	0.0	14.2	-10.0	-17.5					1:30
2041	0.38	1.5	6.02	0.65	0.71	0.60	0.0437	-0.002	15.0	-10.0	-17.4					2:50
2042	0.38	1.5	6.02	0.65	0.71	0.61	0.0418	-0.004	15.7	-10.0	-17.4					4:15
2043	0.38	1.5	6.02	0.65	0.71	0.62	0.0418	-0.004	15.7	-10.0	-17.4					5:35
2044	0.38	1.5	6.02	0.65	0.74	0.63	0.0380	0.0	17.1	-10.0	-17.4					8:00
2045	0.38	1.4	6.03	0.76	0.74	0.71	0.0125	-0.002	60.5	-10.0	-17.4					0:25
2046	0.38	1.5	6.03	0.61	0.74	0.62	0.0406	0.001	15.1	-10.0	-17.4	0.70	60.	20.	0:15	0.28
2047	0.38	1.5	6.03	0.60	0.67	0.60	0.0377	0.002	15.9	-10.0	-17.5					0.38
2048	0.38	1.5	-0.01	-0.04	-0.03	-0.08	0.0091	0.005	-3.9	-10.0	-17.4					1:30
2049	0.38	1.5	-0.02	-0.03	-0.04	-0.07	0.0419	0.004	-0.7	-10.0	-17.5	0.70	60.	20.	0:20	SEE RUN 2056
2050	0.38	1.5	-0.02	-0.03	-0.06	-0.07	0.0408	0.003	-0.7	-10.0	-17.5					2:00
2051	0.38	1.5	-0.02	-0.03	-0.06	-0.07	0.0410	0.004	-0.7	-10.0	-17.5					3:15
2052	0.38	1.5	-0.02	-0.03	-0.05	-0.07	0.0413	0.003	-0.6	-10.0	-17.5					4:35
2053	0.38	1.5	-0.03	-0.02	-0.06	-0.07	0.0397	0.003	-0.6	-10.0	-17.4					5:50
2054	0.38	1.5	-0.02	-0.02	0.00	-0.07	0.0397	0.003	-0.5	-10.0	-17.4					7:10
2055	0.38	1.5	-0.03	-0.03	-0.02	-0.08	0.0398	0.003	-0.7	-10.0	-17.4					8:30
2056	0.38	1.5	-0.04	-0.04	-0.05	-0.11	0.0413	0.006	-1.0	-10.0	-17.4					14:30
2057	0.38	1.5	6.01	0.70	0.73	0.69	0.0122	-0.001	57.3	-10.0	-17.5					0:28
2058	0.38	1.5	6.00	0.61	0.70	0.67	0.0426	0.004	14.3	-10.0	-17.5	0.48	60.	20.	0:15	0.41
2059	0.38	1.5	6.00	0.56	0.71	0.58	0.0345	0.002	16.2	-10.0	-17.5					0.20

FEATHERS REM.

APPENDIX C (CONT)

CONFIGURATION - 1, NACA 0012 AIRFOIL

RUN	MACH	RN	ALPH	CLP	CLPL	CL40	CDW	CMP	L/D	TOT T	STA T	LWC TIME	DIA FREQ	AMP	THICK SPAN	REMARKS
2060	0.58	2.1	6.03	0.90	0.94	0.77	0.0252	0.017	35.7	-10.0	-26.5					
2061	0.58	2.0	6.02	0.73	0.90	0.83	0.0290	-0.010	25.1	-10.0	-26.4	0.38	45.	20.	0.0	0.22 0.34
2062	0.58	2.1	6.00	0.85	0.93	0.77	0.0253	0.012	33.7	-10.0	-26.4					
2063	0.58	2.1	6.00	0.72	0.91	0.88	0.0353	-0.014	20.3	-10.0	-26.5	0.38	60.	20.	0.0	0.31 0.44
2064	0.43	1.6	5.98	0.72	0.75	0.71	0.0139	0.0	52.2	-10.0	-19.6					UNKNOWN
2065	0.45	1.7	5.97	0.57	0.74	0.69	0.0742	-0.001	7.7	-10.0	-20.2	0.66	60.	20.	0.0	
2066	0.48	1.8	6.00	0.76	0.78	0.74	0.0152	0.002	50.3	-10.0	-21.5					
2067	0.48	1.8	6.00	0.59	0.77	0.61	0.0678	-0.003	8.7	-10.0	-21.5	0.66	60.	20.	0.0	0.34 0.53
2068	0.48	1.8	6.02	0.77	0.81	0.74	0.0150	0.003	51.8	-10.0	-21.5					
2069	0.48	1.8	6.01	0.62	0.77	0.62	0.0481	-0.001	12.9	-10.0	-21.6	0.53	60.	20.	0.0	0.30 0.38
2070	0.48	1.8	6.02	0.77	0.81	0.75	0.0153	0.003	50.6	-10.0	-21.5					
2071	0.48	1.8	6.01	0.65	0.78	0.71	0.0443	-0.001	14.7	-10.0	-21.6	0.53	45.	20.	0.0	
2072	0.29	1.1	5.99	0.68	0.68	0.67	0.0129	-0.004	52.6	-10.0	-14.3					0.47
2073	0.29	1.1	5.99	0.60	0.65	0.50	0.0627	0.011	9.5	-10.0	-14.3	1.75	60.	20.	0.0	0.25 0.44
2074	0.29	1.1	6.00	0.68	0.76	0.63	0.0130	-0.004	46.5	-10.0	-14.3					
2075	0.29	1.1	6.00	0.60	0.68	0.51	0.0638	0.009	8.3	-10.0	-14.4	1.00	60.	20.	0.0	0.25 0.31
2076	0.29	1.1	5.96	0.61	0.62	0.56	0.0113	-0.001	48.0	-10.0	-14.4					
2077	0.29	1.1	5.96	0.60	0.61	0.56	0.0323	0.001	16.5	-10.0	-14.3	0.30	60.	20.	0.0	0.13 ROUND
2078	0.58	2.0	2.98	0.40	0.39	0.31	0.0117	0.006	28.1	-10.0	-26.4					
2079	0.58	2.0	2.99	0.34	0.36	0.29	0.0271	0.002	9.8	-10.0	-26.5	0.38	45.	20.	0.0	0.22 0.34
2080	0.38	1.4	6.03	0.67	0.63	0.64	0.0129	-0.004	46.4	-10.0	-17.4					
2081	0.38	1.4	6.05	0.61	0.61	0.46	0.0559	0.018	9.6	-10.0	-17.3	0.48	60.	20.	5.0	9. 0.22 0.39 MEAN ANG=1.5 DEG
2082	0.38	1.4	6.03	0.67	0.72	0.66	0.0127	-0.005	47.5	-10.0	-17.3					
2083	0.38	1.4	6.00	0.59	0.62	0.48	0.0443	0.006	11.7	-10.0	-17.5	0.48	60.	20.	5.0	9. 0.22 0.44
2084	0.38	1.4	5.97	0.66	0.70	0.64	0.0132	-0.003	44.5	-10.0	-17.4					
2085	0.38	1.4	5.96	0.58	0.65	0.50	0.0452	0.001	11.3	-10.0	-17.4	0.48	60.	20.	5.0	9. SEE RUN 2096 TIME INC 0:30
2086	0.38	1.4	5.96	0.58	0.68	0.50	0.0436	0.002	11.8	-10.0	-17.4					1:50
2087	0.38	1.4	5.96	0.58	0.62	0.51	0.0409	0.002	12.5	-10.0	-17.4					3:50
2088	0.38	1.4	5.95	0.59	0.65	0.51	0.0406	0.002	12.9	-10.0	-17.4					5:15
2089	0.38	1.4	5.95	0.59	0.66	0.52	0.0332	0.003	13.7	-10.0	-17.4					6:35
2090	0.38	1.4	5.95	0.59	0.68	0.52	0.0364	0.001	13.5	-10.0	-17.4					7:50
2091	0.38	1.4	5.95	0.59	0.67	0.51	0.0361	0.0	14.4	-10.0	-17.4					9:20
2092	0.38	1.4	5.95	0.59	0.66	0.52	0.0362	0.0	14.4	-10.0	-17.4					10:40
2093	0.38	1.4	5.94	0.59	0.68	0.53	0.0354	-0.001	14.7	-10.0	-17.4					12:00
2094	0.38	1.4	5.94	0.59	0.67	0.53	0.0347	-0.001	15.1	-10.0	-17.4					13:20
2095	0.38	1.4	5.94	0.58	0.66	0.53	0.0342	-0.001	14.9	-10.0	-17.4					14:45
2096	0.38	1.4	5.94	0.58	0.67	0.54	0.0339	-0.002	15.1	-10.0	-17.4					16:00
2097	0.38	1.4	5.92	0.68	0.68	0.66	0.0121	-0.004	50.3	-10.0	-17.4	0.48	60.	20.	0.0	SEE RUN 2104 0:15
2098	0.38	1.4	5.92	0.59	0.65	0.47	0.0502	0.010	10.4	-10.0	-17.4					1:35
2099	0.38	1.4	5.92	0.59	0.65	0.49	0.0465	0.008	11.2	-10.0	-17.4					2:50
2100	0.39	1.4	5.92	0.59	0.65	0.51	0.0437	0.006	11.8	-10.0	-17.4					4:05
2101	0.39	1.4	5.92	0.58	0.61	0.52	0.0411	0.004	12.4	-10.0	-17.4					5:20
2102	0.39	1.4	5.92	0.58	0.64	0.52	0.0407	0.004	12.5	-10.0	-17.4					6:40
2103	0.38	1.4	5.91	0.59	0.62	0.54	0.0401	0.003	12.9	-10.0	-17.4					8:10
2104	0.38	1.4	5.91	0.59	0.66	0.54	0.0392	0.002	13.2	-10.0	-17.4					8:10
2105	0.38	1.4	5.91	0.68	0.70	0.65	0.0132	-0.004	46.4	-10.0	-17.4					MOLD ICE NO.4
2106	0.38	1.4	5.91													

CONFIGURATION - 3, SSC-A09 AIRFOIL

APPENDIX C (CONT)

RUN	MACH	RN	ALPH	CLPH	CLPL	CLAO	COW	CMP	L/D	TOT T	STA T	LWC TIME	DIA TIME	THICK INC	THICK SPAN	REMARKS
2107	0.58	1.9	5.95	0.90	1.03	0.99	0.0289	-0.034	31.2	0.0	-17.1				0.17 0.31	
2108	0.58	1.9	5.93	0.83	0.99	1.02	0.0416	-0.045	20.0	0.0	-17.3	0.38	45.	20.	0.17 0.31	
2109	0.58	1.9	5.95	0.91	0.95	1.00	0.0259	-0.031	31.1	0.0	-17.1				0.17 0.31	
2110	0.58	1.9	5.95	0.90	0.97	1.00	0.0357	-0.044	24.0	0.0	-17.2	0.35	45.	20.	0.19 0.16	
2111	0.58	2.0	5.95	0.86	0.99	1.03	0.0239	-0.033	37.6	-5.0	-21.7				0.19 0.16	
2112	0.58	2.0	5.95	0.90	0.97	0.99	0.0334	-0.040	25.4	-5.0	-21.9	0.35	45.	20.	0.19 0.22	
2113	0.58	2.0	5.95	0.85	0.97	0.96	0.0334	-0.040	36.3	-5.0	-22.0				0.19 0.22	
2114	0.58	2.0	5.95	0.90	0.96	0.97	0.0249	-0.032	19.5	-10.0	-17.5	0.48	60.	20.	0.20 0.25	
2115	0.58	2.0	5.95	0.83	0.96	0.96	0.0348	-0.043	24.0	-5.0	-21.9	0.38	45.	20.	0.20 0.25	
2116	0.38	1.4	5.95	0.79	0.83	0.88	0.0099	-0.035	79.4	-10.0	-17.3				SEE RUN 2129	
2117	0.38	1.4	5.95	0.72	0.78	0.82	0.0392	-0.032	18.4	-10.0	-17.5	0.48	60.	20.	0:20	
2118	0.38	1.4	5.95	0.69	0.77	0.83	0.0352	-0.032	21.2	-10.0	-17.5				1:30	
2119	0.38	1.4	5.95	0.70	0.78	0.86	0.0329	-0.033	21.2	-10.0	-17.5				2:55	
2120	0.38	1.4	5.95	0.70	0.81	0.82	0.0321	-0.034	21.7	-10.0	-17.5				4:20	
2121	0.38	1.4	5.95	0.69	0.79	0.83	0.0316	-0.035	21.9	-10.0	-17.5				5:40	
2122	0.38	1.4	5.95	0.68	0.78	0.80	0.0303	-0.035	22.3	-10.0	-17.5				7:00	
2123	0.38	1.4	5.95	0.68	0.76	0.82	0.0273	-0.035	24.9	-10.0	-17.5				8:15	
2124	0.38	1.4	5.95	0.69	0.82	0.83	0.0275	-0.036	25.3	-10.0	-17.4				9:35	
2125	0.38	1.4	5.95	0.68	0.78	0.83	0.0266	-0.038	25.6	-10.0	-17.4				10:50	
2126	0.38	1.4	5.95	0.69	0.82	0.85	0.0254	-0.039	27.2	-10.0	-17.4				12:10	
2127	0.38	1.4	5.95	0.70	0.81	0.85	0.0257	-0.039	27.2	-10.0	-17.4				13:30	
2128	0.38	1.4	5.95	0.68	0.78	0.82	0.0247	-0.038	27.5	-10.0	-17.4				14:55	
2129	0.38	1.4	5.95	0.69	0.81	0.87	0.0244	-0.039	28.3	-10.0	-17.4				16:15 0.19 0.16	
2130	0.46	1.3	5.95	0.91	1.00	0.97	0.0235	-0.031	39.3	-10.0	-15.8				0.28 0.27	
2131	0.58	2.0	5.95	0.91	0.84	0.97	0.0339	-0.051	24.9	-10.0	-26.5	0.49	60.	20.	0.25 RTIME	
2132	0.58	2.0	5.95	0.93	1.00	0.95	0.0230	-0.031	39.4	-20.0	-35.9				0.22 RTIME	
2133	0.58	2.1	5.95	0.91	0.91	0.95	0.0231	-0.029	40.1	-20.0	-36.1				0.22 RTIME	
2134	0.58	2.1	5.95	0.86	0.99	0.98	0.0293	-0.041	29.2	-20.0	-36.0	0.53	45.	20.	0.31 RTIME	
2135	0.58	2.1	5.95	0.93	0.95	0.96	0.0295	-0.044	29.2	-20.0	-36.1				0.31 RTIME	
2136	0.58	2.1	5.95	0.86	0.97	1.02	0.0217	-0.032	42.2	-20.0	-35.8				0.31 RTIME	
2137	0.58	2.1	5.91	0.91	0.99	0.96	0.0290	-0.044	28.6	-20.0	-36.0	0.62	45.	20.	0.31 RTIME	
2138	0.58	2.1	5.95	0.83	0.95	0.97	0.0339	-0.036	79.5	-20.0	-24.3				0.16 0.25	
2139	0.29	1.2	5.95	0.79	0.76	0.87	0.0099	-0.031	80.7	-20.0	-24.2	0.66	60.	20.	0.28 0.13	
2140	0.29	1.2	5.95	0.70	0.78	0.87	0.0291	-0.039	24.2	-20.0	-24.2				0.28 0.13	
2141	0.29	1.2	5.95	0.76	0.68	0.86	0.0095	-0.031	80.7	-20.0	-24.2				0.28 0.13	
2142	0.29	1.2	5.95	0.65	0.73	0.82	0.0339	-0.036	79.7	-20.0	-24.3	1.00	60.	20.	0.28 0.13	
2143	0.29	1.1	5.95	0.77	0.74	0.85	0.0106	-0.033	73.0	-5.0	-9.3	1.00	60.	20.	0.08 0.13	
2144	0.29	1.1	5.95	0.73	0.70	0.88	0.0775	-0.027	9.4	-5.0	-9.3				0.22 0.28	
2145	0.29	1.1	5.95	0.78	0.78	0.87	0.0093	-0.034	79.8	-5.0	-9.3				0.22 0.28	
2146	0.29	1.1	5.95	0.72	0.78	0.73	0.0570	-0.019	12.6	-5.0	-9.3	0.66	60.	20.	0.16 ROUND	
2147	0.29	1.1	5.95	0.78	0.77	0.86	0.0098	-0.032	79.7	-5.0	-9.3				0.16 ROUND	
2148	0.29	1.1	5.95	0.73	0.71	0.85	0.0291	-0.030	25.0	-5.0	-9.4	0.35	60.	20.	0.16 0.25	
2149	0.58	2.0	0.00	0.18	0.08	0.12	0.0038	0.003	21.0	-10.0	-26.5				0.22 0.28	
2150	0.58	2.0	0.00	0.21	0.06	0.16	0.0307	0.004	6.8	-10.0	-26.4	0.35	45.	20.	TIME INC 0:30	
2151	0.58	2.0	0.00	0.21	0.06	0.11	0.0092	0.010	22.7	-10.0	-26.5				TIME INC 1:45	
2152	0.58	2.0	0.00	0.19	0.06	0.12	0.0191	0.008	8.6	-10.0	-26.3	0.33	45.	20.	SEE RUN 2160 3:00	
2153	0.58	2.0	0.00	0.18	0.06	0.11	0.0173	0.008	10.1	-10.0	-26.5					
2154	0.58	2.0	0.00	0.18	0.06	0.11	0.0173	0.008								

APPENDIX C (CONT)

CONFIGURATION - 3, SSC-A09 AIRFOIL

RUN	MACH	RN	ALPH	CLP	CLPL	CL40	CDW	CMP	L/D	TOT T	STA T	LWC TIME	DIA FREQ	AMP	THICK SPAN	REMARKS
2155	0.58	2.0	0.00	0.17	0.05	0.10	0.0170	0.007	10.2	-10.0	-26.4					TIME INC 4:15
2156	0.58	2.0	0.00	0.17	0.05	0.11	0.0167	0.006	10.4	-10.0	-26.4					5:40
2157	0.58	2.0	0.00	0.18	0.05	0.11	0.0154	0.006	11.3	-10.0	-26.4					7:05
2158	0.58	2.0	0.00	0.18	0.06	0.11	0.0152	0.005	11.6	-10.0	-26.4					8:30
2159	0.58	2.0	0.00	0.18	0.05	0.11	0.0159	0.006	11.4	-10.0	-26.4					9:50
2160	0.58	2.0	0.00	0.18	0.06	0.12	0.0154	0.006	11.7	-10.0	-26.4					11:10
2161	0.39	1.4	6.00	0.76	0.81	0.88	0.0101	-0.043	75.9	-10.0	-17.4					MOLD, ICE NO. 3
2162	0.39	1.4	6.00							-10.0	-17.4					

CONFIGURATION - 4, VR-7 AIRFOIL

RUN	MACH	RN	ALPH	CLP	CLPL	CL40	CDW	CMP	L/D	TOT T	STA T	LWC TIME	DIA FREQ	AMP	THICK SPAN	REMARKS
2163	0.29	1.2	5.86	1.06	0.0087		121.5	-10.0	-14.3							
2164	0.29	1.2	5.84	0.96	0.0290		33.1	-10.0	-14.4	0.30	60.	20.	0.0	0.	0.09	0.19
2165	0.29	1.2	5.82	0.95	0.0100		95.1	-10.0	-14.3							
2166	0.29	1.2	5.82	0.89	0.0376		23.6	-10.0	-14.3	1.20	60.	20.	0.0	0.	0.22	0.34
2167	0.36	1.5	5.83	1.04	0.0112		93.0	-10.0	-17.4							
2168	0.36	1.5	5.83	0.96	0.0356		27.0	-10.0	-17.5	0.76	60.	20.	0.0	0.	0.23	0.31
2169	0.36	1.5	5.85	1.00	0.0090		111.1	-10.0	-17.5							
2170	0.36	1.5	5.85	0.96	0.0643		15.0	-10.0	-17.5	1.40	60.	20.	0.0	0.	0.31	0.50
2171	0.36	1.5	5.84	1.06	0.0087		122.2	-10.0	-17.4							
2172	0.36	1.5	5.84	1.00	0.0402		24.9	-10.0	-17.4	1.00	60.	20.	0.0	0.	0.25	0.38
2173	0.48	1.9	5.86	1.11	0.0096		115.3	-10.0	-21.7							
2174	0.48	1.9	5.86	1.08	0.0368		29.3	-10.0	-21.7	1.00	30.	20.	0.0	0.	0.19	0.38
2175	0.48	1.9	5.85	1.13	0.0102		110.9	-10.0	-21.6							
2176	0.48	1.9	5.85	1.07	0.0692		15.5	-10.0	-21.6	1.00	60.	20.	0.0	0.	0.34	0.63
2177	0.48	1.9	5.84	1.14			136.4	-10.0	-21.6							
2178	0.48	1.9	5.84	0.98			8.7	-10.0	-21.7	1.00	90.	20.	0.0	0.	0.56	0.72
2179	0.56	2.2	5.83	1.19			92.0	-10.0	-26.6							
2180	0.59	2.2	5.83	1.10			55.8	-10.0	-27.0	0.30	45.	20.	0.0	0.	0.14	0.19
2181	0.58	2.2	5.83	1.21			108.9	-10.0	-26.7							
2182	0.59	2.2	5.83	1.15			39.1	-10.0	-27.0	0.66	45.	20.	0.0	0.	0.25	0.41
2183	0.58	2.2	5.83	1.23			110.9	-10.0	-26.5							
2184	0.58	2.2	5.83	1.11			21.0	-10.0	-26.6	1.00	45.	20.	0.0	0.	0.36	0.50
2185	0.29	1.2	10.00						-10.0	-14.2						
2186	0.29	1.2	10.00													
2187	0.29	1.2	6.00	1.50	0.0201		74.6	-10.0	-14.2							
2188	0.48	1.9	6.00	1.33	0.0396		33.5	-10.0	-14.4	0.66	60.	20.	0.0	0.	0.19	0.25
2189	0.48	1.9	6.00	1.11	0.0086		128.8	-10.0	-21.6							
2190	0.48	1.9	6.00	1.05	0.0916		11.5	-10.0	-21.6	1.00	60.	20.	0.0	0.	0.44	0.63
2191	0.48	1.9	6.00	1.12	0.0093		120.2	-10.0	-21.6							
2192	0.48	1.9	6.00	0.86	0.1702		5.0	-10.0	-21.8	1.00	90.	20.	0.0	0.	0.66	0.91
2193	0.58	2.2	6.00	1.23	0.0208		58.9	-10.0	-26.4							
2194	0.58	2.2	6.00	1.17	0.0334		35.0	-10.0	-26.5	0.30	45.	20.	0.0	0.	0.16	0.28
2195	0.58	2.2	6.10	1.25	0.0207		60.6	-10.0	-26.5							
2196	0.59	2.2	6.10	1.23	0.0492		25.0	-10.0	-27.0	0.66	45.	20.	0.0	0.	0.28	0.38
2197	0.50	1.9	5.86	1.13	0.0059		128.9	-10.0	-22.3							

APPENDIX C (CONT)

CONFIGURATION - 4, VR-7 AIRFOIL

RUN	MACH	RN	ALPH	CLP	CLPL	CL40	CDW	CMP	L/D	TOT T	STA T	LWC TIME	DIA FREQ	AMP	THICK SPAN	REMARKS
2198	0.58	2.2	5.87	1.24	0.0203		61.0	-10.0	-26.5							
2199	0.59	2.2	5.87	1.13	0.0761		14.9	-10.0	-26.8	1.00	45.	20.	0.0	0.	0.44	0.47

CONFIGURATION - 13, NACA 0012 AIRFOIL WITH ICE NO.4 (FROM RUN 2106)

RUN	MACH	RN	ALPH	CLP	CLPL	CL40	CDW	CMP	L/D	TOT T	STA T
2200	0.38	1.4	0.12	-0.02	0.0231		-0.8	-10.0	-17.4		
2201	0.39	1.4	2.97	0.32	0.0230		13.9	-10.0	-17.5		
2202	0.38	1.4	5.91	0.66	0.0283		23.3	-10.0	-17.4		
2203	0.39	1.4	8.98	0.94	0.0541		17.4	-10.0	-17.4		

CONFIGURATION - 14, NACA 0012 AIRFOIL WITH ICE NO.4A (ICE NO.4 WITH LOWER SURFACE FEATHERS REMOVED)

RUN	MACH	RN	ALPH	CLP	CLPL	CL40	CDW	CMP	L/D	TOT T	STA T
2204	0.38	1.4	-0.02	-0.04	0.0205		-1.9	-5.0	-12.6		
2205	0.38	1.4	3.00	0.35	0.0201		17.4	-5.0	-12.6		
2206	0.38	1.4	5.99	0.67	0.0259		25.9	-5.0	-12.5		
2207	0.38	1.4	8.91	0.96	0.0493		19.5	-5.0	-12.5		

CONFIGURATION - 15, SSC-A09 AIRFOIL WITH ICE NO.3 (FROM RUN 2162)

RUN	MACH	RN	ALPH	CLP	CLPL	CL40	CDW	CMP	L/D	TOT T	STA T
2208	0.38	1.4	-0.04	0.04	0.0173		2.3	-10.0	-17.4		
2209	0.38	1.4	3.02	0.42	0.0174		24.1	-10.0	-17.5		
2210	0.38	1.4	5.97	0.80	0.0221		36.2	-10.0	-17.4		
2211	0.39	1.4	8.99	1.15	0.0457		25.2	-10.0	-17.4		

CONFIGURATION - 16, NACA 0012 AIRFOIL WITH ICE NO.4B (ICE NO.4A CUT TO 6 INCH SPAN)

RUN	MACH	RN	ALPH	CLP	CLPL	CL40	CDW	CMP	L/D	TOT T	STA T
2212	0.38	1.4	-0.35	-0.05	0.0223		-2.2	-10.0	-17.5		
2213	0.38	1.4	2.96	0.32	0.0206		15.5	-10.0	-17.4		
2214	0.39	1.4	5.93	0.66	0.0256		25.8	-10.0	-17.5		
2215	0.38	1.4	8.91	0.99	0.0529		18.7	-10.0	-17.4		

APPENDIX C (CONT)

CONFIGURATION - 3, SSC-A09 AIRFOIL

RUN	MACH	RN	ALPH	CLP	CLPL	CL40	CDW	CMP	L/D	TOT T	STA T	LWC TIME	DIA FREQ	AMP	THICK SPAN	REMARKS	
2216	0.58	2.0	2.89	0.53	0.54	0.52	0.0052	-0.027	101.3	-10.0	-26.5						
2217	0.58	2.0	6.00	0.78	0.99	0.95	0.0237	-0.023	33.0	-10.0	-26.3						
2218	0.58	2.0	5.92	0.74	0.98	0.87	0.0740	-0.053	9.9	-10.0	-26.5	0.85	60.	20.	0.0	0.41 0.50	
2219	0.58	2.1	5.87	0.94	0.99	0.92	0.0240	-0.038	39.3	-18.9	-35.0						
2220	0.58	2.1	5.86	0.82	0.97	0.96	0.0355	-0.049	23.1	-18.9	-34.7	0.66	45.	20.	0.0	0.31 0.16	
2221	0.58	2.1	5.87	0.94	1.01	0.93	0.0219	-0.039	43.0	-18.9	-34.8						
2222	0.58	2.1	5.87	0.79	0.98	1.02	0.0387	-0.057	20.5	-18.9	-34.9	1.00	45.	20.	0.0	0.41 0.28	
2223	0.58	2.0	5.86	0.92	0.96	0.91	0.0248	-0.038	36.9	-5.0	-21.7						
2224	0.58	2.0	5.87	0.90	0.96	1.02	0.0376	-0.045	23.9	-5.0	-21.9	0.66	45.	20.	0.0	ICE SHED	
2225	0.58	1.9	5.86	0.76	0.95	0.89	0.0415	-0.041	18.4	0.0	-17.2	0.66	45.	20.	0.0	0.25 0.09	
2226	0.58	2.0	5.88	0.81	0.96	0.89	0.0489	-0.045	16.5	-5.0	-21.8	0.66	45.	20.	0.0	0.28 0.38	
2227	0.58	2.0	0.01	0.13	0.05	0.08	0.0090	-0.005	16.6	-10.0	-26.5					TIME INC	
2228	0.57	2.0	0.01	0.11	0.04	0.15	0.0444	-0.013	2.4	-10.0	-25.9	0.58	45.	20.	5.0	SEE RUN 2234 0:40	
2229	0.58	2.0	0.02	0.11	0.04	0.16	0.0404	-0.014	2.6	-10.0	-26.5					1:50	
2230	0.58	2.0	0.02	0.11	0.03	0.14	0.0386	-0.012	2.8	-10.0	-26.6					3:05	
2231	0.58	2.0	0.01	0.11	0.03	0.13	0.0382	-0.011	2.9	-10.0	-26.5					4:20	
2232	0.58	2.0	0.01	0.12	0.03	0.14	0.0360	-0.011	3.3	-10.0	-26.5					5:35	
2233	0.58	2.0	0.00	0.01	0.21	0.00	0.12	0.0372	0.004	5.6	-10.0	-26.5	0.0	45.	0.	5.0	0.0 0.0 6:50
2234	0.58	2.0	0.00	0.13	0.03	0.12	0.0367	-0.009	3.5	-10.0	-26.4	0.25	0.31			8:10	

CONFIGURATION - 7, OH-58 TAIL ROTOR

RUN	MACH	RN	ALPH	CLP	CLPL	CL40	CDW	CMP	L/D	TOT T	STA T	LWC TIME	DIA FREQ	AMP	THICK SPAN	REMARKS
2235																NO DATA
2236	0.58	1.8	6.09	0.77	0.0415	18.6	-10.0	-26.5	4.4	-10.0	-25.7	1.00	45.	20.	0.0	0.41 0.59
2237	0.56	1.7	6.09	0.57	0.1316											NO DATA
2238																

CONFIGURATION - 12, H-34 MODEL ROTOR BLADE

RUN	MACH	RN	ALPH	CLP	CLPL	CL40	CDW	CMP	L/D	TOT T	STA T	LWC TIME	DIA FREQ	AMP	THICK SPAN	REMARKS
2239	0.58	0.9	6.01	0.81	0.0245	32.9	-10.0	-26.3								
2240	0.58	0.9	6.01	0.31	0.2457	1.2	-10.0	-26.4	0.66	45.	20.	0.0	0.	0.28	0.59	
2241	0.58	0.9	6.00	0.86	0.0233	37.1	-10.0	-26.4								
2242	0.58	0.9	6.00	0.38	0.0697	5.4	-10.0	-26.4	1.00	45.	20.	0.0	0.	0.31 0.44	LOST 1/2 ICE	
2243	0.56	0.9	6.00	0.24	0.1218	1.9	-10.0	-25.6	1.00	45.	20.	0.0	0.	UNKNOWN	LOST ICE	
2244	0.57	0.9	6.00	0.22	0.2093	1.1	-10.0	-25.9	1.00	30.	20.	0.0	0.	0.27	0.44 SHED DURING DATA	
2245	0.58	0.9	3.04	0.30	0.0147	20.4	-10.0	-26.4	-0.2	-10.0	-26.8	0.66	45.	20.	0.0	0.34 0.44
2246	0.59	0.9	3.04	-0.06	0.2640											
2247	0.58	0.9	0.09	-0.05	0.0110	-4.3	-10.0	-26.4	-1.1	-10.0	-28.1	0.66	45.	20.	0.0	0.34 0.44
2248	0.61	0.9	0.09	-0.04	0.0355											

APPENDIX C (CONT)

CONFIGURATION - 1, NACA 0012 AIRFOIL

RUN	MACH	RN	ALPH	CLP	CLPL	CL40	CDW	CMP	L/D	TOT T	STA T	LNC TIME	DIA FREQ	AMP	THICK SPAN	REMARKS		
2249	0.49	1.8	6.13	0.76	0.68	0.0151	50.3	-10.0	-21.9	0.94	45.	20.	0.0	0.	0.31	0.63		
2250	0.49	1.8	6.13	0.76	0.68	0.0994	-0.143	7.7	-10.0	-21.9	0.94	60.	20.	0.0	0.	0.31	0.63	
2251	0.49	1.8	6.15	0.74	0.73	0.0151	0.006	49.3	-10.0	-21.8	0.94	60.	20.	0.0	0.	0.38	0.78	
2252	0.49	1.8	6.14	0.46	0.56	0.74	0.1246	-0.041	3.7	-10.0	-21.8	0.94	60.	20.	0.0	0.	0.38	0.78
2253	0.29	1.1	3.97	0.44	0.41	0.35	0.0112	39.7	-5.0	-9.5	1.30	90.	20.	0.0	0.	0.31	0.81	
2254	0.29	1.1	3.94	0.34	0.40	0.64	0.1221	-0.026	2.8	-5.0	0.007	53.8	-10.0	-17.5	0.30	300.	0.63	0.22
2255	0.38	1.4	5.98	0.72	0.75	0.69	0.0134	-0.024	17.8	-10.0	-17.5	0.30	300.	20.	0.0	0.	0.63	0.22
2256	0.38	1.4	5.97	0.51	0.79	0.63	0.0289	-0.024	17.8	-10.0	-17.5	0.30	300.	20.	0.0	0.	0.63	0.22
2257	0.58	2.0	5.96	0.86	0.91	0.73	0.0150	0.006	63.3	-10.0	-26.7							
2258	0.58	2.0	5.93	0.82	0.89	0.75	0.0250	0.012	32.9	-10.0	-26.7	0.66	45.	20.	0.0	0.	0.31	0.44
2259	0.58	2.0	5.92	0.65	0.83	0.73	0.0363	-0.013	18.0	-10.0	-26.9	0.66	60.	20.	0.0	0.	0.31	0.44
2260	0.59	2.0	5.92	0.86	0.89	0.73	0.0246	0.014	34.8	-10.0	-26.9	0.66	60.	20.	0.0	0.	0.34	0.50
2261	0.58	2.0	5.92	0.66	0.84	0.81	0.0426	-0.013	15.6	-10.0	-26.8	0.66	60.	20.	0.0	0.	0.34	0.50
2262	0.58	2.0	5.92	0.89	0.89	0.74	0.0235	0.022	37.8	-10.0	-26.6	0.66	60.	20.	0.0	0.	0.22	0.44
2263	0.59	2.0	5.92	0.80	0.83	0.90	0.0338	0.010	23.8	-10.0	-26.9	0.94	20.	20.	0.0	0.	0.22	0.44
2264	0.58	2.0	5.91	0.89	0.93	0.86	0.0243	0.001	36.7	-10.0	-26.5							
2265	0.58	2.0	5.91	0.56	0.75	0.63	0.0925	-0.018	6.0	-10.0	-26.8	0.66	60.	20.	0.0	0.	0.34	0.63
2266	0.58	2.0	5.90	0.85	0.89	0.73	0.0239	0.009	35.8	-10.0	-26.8	0.66	60.	20.	0.0	0.	0.34	0.63
2267	0.58	2.0	5.99	0.46	0.58	0.50	0.1547	-0.034	3.1	-10.0	-26.8	0.94	60.	20.	0.0	0.	0.50	0.78
2268	0.58	2.0	5.99	0.84	0.89	0.74	0.0228	0.010	36.9	-10.0	-26.9	0.66	60.	20.	0.0	0.	0.16	0.19
2269	0.58	2.0	5.99	0.72	0.84	0.75	0.0284	-0.006	25.5	-10.0	-26.8	0.66	60.	20.	0.0	0.	0.28	0.56
2270	0.58	2.0	5.99	0.85	0.89	0.74	0.0265	0.008	32.0	-5.0	-22.1	0.66	60.	20.	0.0	0.	0.25	0.56
2271	0.59	2.0	5.98	0.65	0.84	0.78	0.0472	-0.013	13.7	-5.0	-22.3	0.66	45.	20.	0.0	0.	0.25	0.56
2272	0.58	2.0	5.99	0.35	0.35	0.29	0.0121	0.003	28.9	-10.0	-26.5	0.66	45.	20.	0.0	0.	0.31	0.53
2273	0.58	2.0	2.96	0.29	0.33	0.20	0.0585	0.007	4.9	-10.0	-26.9	0.66	60.	20.	0.0	0.	0.22	0.53
2274	0.29	1.1	5.99	0.62	0.60	0.60	0.0136	-0.001	45.6	-10.0	-14.4							
2275	0.29	1.1	5.90	0.53	0.59	0.57	0.0838	-0.001	6.3	-10.0	-14.4	1.40	60.	20.	0.0	0.	0.28	0.28
2276	0.29	1.1	5.97	0.62	0.67	0.59	0.0125	-0.007	49.2	-5.0	-9.3							
2277	0.29	1.1	5.97	0.53	0.61	0.83	0.1063	-0.018	5.0	-5.0	-9.4	1.40	60.	20.	0.0	0.	0.22	0.31
2278	0.58	2.0	5.97	0.79	0.82	0.71	0.0225	0.009	34.9	-3.9	-21.0							
2279	0.58	1.9	5.97	0.77	0.81	0.71	0.0231	0.009	33.5	0.0	-17.1							
2280	0.58	1.9	5.97	0.62	0.75	0.68	0.0518	0.001	12.0	0.0	-17.3	0.66	45.	20.	0.0	0.	0.25	0.09

CONFIGURATION - 17, CIRCULATION CONTROL AIRFOIL

RUN	MACH	RN	ALPH	CLP	CLPL	CL40	CDW	CMP	L/D	TOT T	STA T	LNC TIME	DIA FREQ	AMP	THICK SPAN	REMARKS		
2281	0.30	1.1	0.0	0.44	0.36	0.92	0.0353	-0.119	12.6	-10.0	-14.5							
2282	0.29	1.1	0.01	0.48	0.31	0.78	0.0321	-0.134	14.8	-10.0	-14.4	0.66	60.	20.	0.0	0.	0.13	0.50
2283	0.29	1.1	0.0	0.33	0.20	0.58	0.0442	-0.106	7.4	-10.0	-14.4							
2284	0.48	1.7	-0.01	0.33	0.25	0.69	0.0352	-0.102	9.5	-10.0	-21.7							
2285	0.49	1.8	-0.01	0.35	0.26	0.70	0.0355	-0.106	10.4	-10.0	-21.9							
2286	0.48	1.8	0.0	0.28	0.14	0.56	0.0547	-0.080	5.5	-10.0	-21.6	0.66	60.	20.	0.0	0.	0.38	0.63
2287	0.58	2.0	0.0	0.31	0.18	0.71	0.0386	-0.110	8.4	-10.0	-26.6							
2288	0.58	2.0	0.0	0.32	0.19	0.72	0.0321	-0.117	10.5	-10.0	-26.5							
2289	0.58	2.0	0.03	0.25	0.09	0.55	0.0369	-0.074	7.2	-10.0	-26.7	0.66	45.	20.	0.0	0.	0.28	0.50
2290	0.58	2.0	0.02	0.31	0.17	0.79	0.0378	-0.109	8.7	-10.0	-26.6							
2291																	NO DATA	

APPENDIX C (CONT)

CONFIGURATION - 17, CIRCULATION CONTROL AIRFOIL

RUN	MACH	RN	ALPH	CLPH	CLPL	CL40	CDW	CMP	L/D	TOT T	STA T	LWC TIME	DIA FREQ AMP	THICK SPAN	REMARKS			
2292	0.59	2.0	0.02	0.26	0.09	0.55	0.0340	-0.073	8.8	-10.0	-26.8	0.66	45.	20.	0.0	0.26	0.53	
2293	0.49	1.8	0.02	0.30	0.25	0.72	0.0284	-0.105	11.0	-10.0	-21.7							
2294	0.49	1.8	0.02	0.19	0.12	0.60	0.0448	-0.078	4.7	-10.0	-21.8	0.66	60.	20.	0.0	0.	0.25	0.56
2295	0.29	1.1	0.01	0.20	0.18	0.60	0.0455	-0.068	4.6	-10.0	-14.4							
2296	0.29	1.1	0.01	0.13	0.09	0.55	0.0387	-0.059	3.7	-10.0	-14.3	0.66	60.	20.	0.0	0.09	ROUND	
2297	0.29	1.1	-0.01	0.37	0.27	0.74	0.0311	-0.115	13.0	-10.0	-14.3							
2298	0.29	1.1	-0.01	0.39	0.34	0.78	0.0264	-0.116	14.8	-10.0	-14.4							
2299	0.29	1.1	-0.01	0.23	0.10	0.63	0.0451	-0.085	6.1	-10.0	-14.3	0.66	60.	20.	0.0	0.	0.25	0.63
2300	0.30	1.1	6.06	0.90	0.90	1.41	0.0308	-0.092	35.9	-10.0	-14.3							
2301	0.29	1.1	6.05	0.86	0.66	1.41	0.0372	-0.080	27.5	-10.0	-14.3							
2302	0.29	1.1	6.05	0.70	0.75	1.24	0.0367	-0.060	22.7	-10.0	-14.3	0.66	60.	20.	0.0	0.	0.16	0.50

CONFIGURATION - 2, SC1095 AIRFOIL

RUN	MACH	RN	ALPH	CLPH	CLPL	CL40	CDW	CMP	L/D	TOT T	STA T	LWC TIME	DIA FREQ AMP	THICK SPAN	REMARKS			
2303	0.29	1.0	0.00	0.04	0.08	0.04	0.0079	-0.013	4.4	0.0	-4.3							
2304	0.29	1.0	0.00	0.00	0.00	0.00				0.8	-3.7	.66	20.	0.0	0.	0.0	0.0	
2305	0.58	1.0	0.00	0.00	0.43	0.45	0.41	0.0706	-0.017	6.0	5.0/3.4-13.1/-14.6	.66	20.	0.0	0.	0.0	ONSET OF ICE	
2306	0.59	2.0	3.00	0.43	0.45	0.41	0.0706	-0.017	6.0	5.0/3.4-13.1/-14.6	.66	20.	0.0	0.	0.0	ONSET OF ICE		
2307	0.59	2.0	6.00	0.76	0.88	0.88	0.0973	-0.047	7.8	6.2/4.1-11.7/-13.7	.66	20.	0.0	0.	0.0	ONSET OF ICE		
2308	0.58	1.9	6.00	0.76	0.88	0.88	0.0973	-0.047	7.8	5.0	-12.5	0.66	45.	20.	0.0	0.	BEAK ICE	
2309	0.58	1.9	6.00	0.55	0.54	0.51	0.0134	-0.017	41.4	6.5	-11.1	0.50	20.	0.0	0.	0.0	ONSET OF ICE	
2310	0.58	2.0	3.00	0.42	0.42	0.42	0.0944	-0.055	4.4	2.2	-17.1	1.40	45.	20.	0.	0.	DOUBLE BEAK	
2311	0.58	2.0	3.00	0.45	0.53	0.43	0.0107	-0.015	42.3	-10.0	-26.4							
2312	0.58	2.0	3.00	0.43	0.46	0.45	0.0309	-0.015	13.8	-10.0	-26.3	0.66	45.	20.	0.	0.	0.22	0.34
2313	0.58	2.0	0.00	0.10	0.07	0.02	0.0096	-0.004	10.4	-10.0	-26.2							
2314	0.57	2.0	0.00	0.13	0.07	0.07	0.0456	0.0	2.8	-10.0	-26.4	0.66	45.	20.	0.	0.	0.28	0.38
2315	0.58	2.0	6.00	0.82	0.80	0.82	0.0108	-0.026	76.3	-10.0	-14.2	1.00	60.	20.	0.	0.	0.19	0.34
2316	0.29	1.1	6.00	0.82	0.80	0.82	0.0108	-0.026	76.3	-10.0	-14.2	1.00	60.	20.	0.	0.	0.28	0.19
2317	0.29	1.1	6.00	0.69	0.75	0.70	0.0477	-0.016	14.4	-10.0	-21.6	0.66	45.	20.	0.	0.	0.28	0.22
2318	0.28	1.1	6.00	0.86	0.85	0.69	0.0106	-0.023	80.9	-10.0	-14.0							
2319	0.29	1.1	6.00	0.65	0.70	0.94	0.0991	-0.042	6.7	-10.0	-14.3	1.40	60.	20.	0.	0.	0.28	0.59
2320	0.58	2.0	6.00	0.97	1.03	0.81	0.0241	-0.014	42.9	-10.0	-26.5							
2321	0.58	2.1	6.00	0.91	1.03	0.91	0.029	-0.029	46.5	-15.0	-31.3	0.66	45.	20.	0.	0.	0.28	0.19
2322	0.58	2.1	6.00	0.81	1.04	0.88	0.0331	-0.036	24.5	-15.0	-31.2	0.66	45.	20.	0.	0.	0.28	0.22
2323	0.58	2.0	6.00	0.95	1.01	0.81	0.0322	-0.015	29.6	-5.0	-21.6							
2324	0.58	2.0	6.00	0.84	0.99	0.94	0.0407	-0.027	20.6	-5.0	-21.7	0.66	45.	20.	0.	0.	0.25	0.50
2325	0.58	1.9	6.00	0.96	0.98	0.84	0.0337	-0.017	28.5	0.0	-16.9							
2326	0.58	1.9	6.00	0.83	0.97	0.87	0.0379	-0.028	21.9	0.0	-17.0	0.66	45.	20.	0.	0.	0.13	0.06
2327	0.29	1.1	6.00	0.62	0.81	0.60	0.0123	-0.024	67.1	0.0	-4.4							
2328	0.29	1.0	6.00	0.77	0.82	0.71	0.0339	-0.022	22.7	0.0	-4.3	0.66	60.	20.	0.	0.	0.19	0.13

APPENDIX C (CONT)

CONFIGURATION - 6, SC1012 R8 AIRFOIL

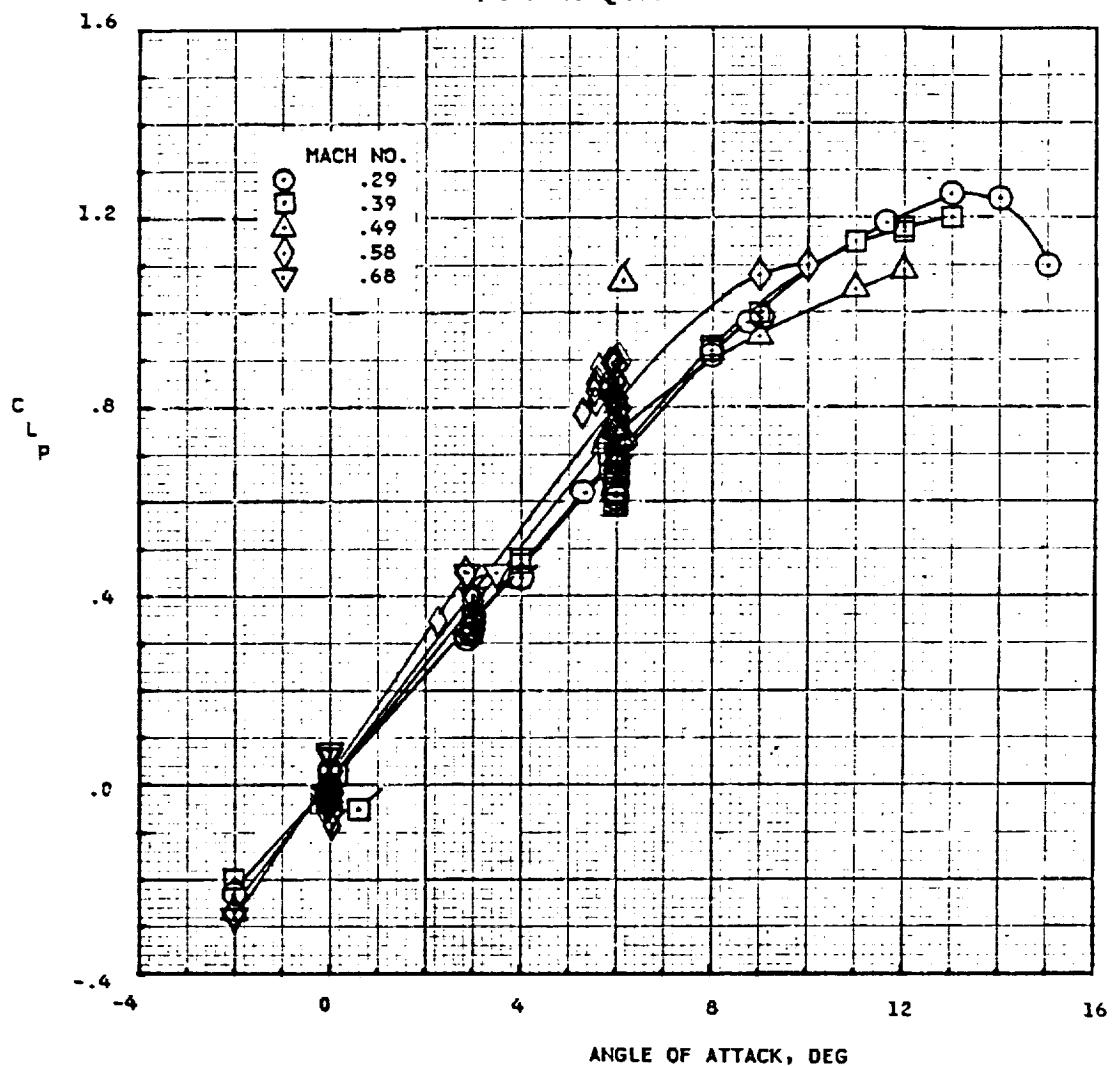
RUN	HACH	RN	ALPH	CLP	CLPL	CL40	CDW	CMP	L/D	TOT T	STA T	LWC TIME	DIA FREQ	AMP	THICK SPAN	REMARKS
2329	0.38	1.5	5.93	0.84	0.85	0.85	0.0170	-0.035	49.8	-10.0	-17.5					0.47 0.38
2330	0.38	1.5	5.94	0.69	0.77	0.75	0.0346	-0.036	19.9	-10.0	-17.4	0.30	300.	20.	0.0	0.47 0.38
2331	0.58	2.0	6.01	0.99	1.04	0.91	0.0360	-0.041	27.5	-10.0	-26.4					0.31 0.47
2332	0.58	2.1	6.01	0.72	0.97	1.05	0.0494	-0.071	14.5	-10.0	-26.5	0.90	45.	20.	0.0	0.31 0.47
2333	0.57	2.1	5.99	0.98	1.00	0.91	0.0357	-0.038	27.3	-10.0	-26.2					0.50 0.53
2334	0.58	2.1	6.00	0.60	0.84	0.78	0.0678	-0.061	8.9	-10.0	-26.3	0.90	60.	20.	0.0	0.50 0.53
2335	0.58	2.1	5.99	0.96	1.03	0.89	0.0359	-0.040	26.8	-10.0	-26.4					
2336	0.58	2.1	5.99	0.87	0.99	0.86	0.0411	-0.043	21.1	-10.0	-26.6	0.90	20.	20.	0.0	0.19 0.34
2337	0.58	2.0	-0.19	0.05	0.03	0.12	0.0131	-0.039	4.2	-10.0	-26.3					
2338	0.58	2.1	-0.19	-0.11	-0.01	-0.27	0.0996	-0.019	-1.1	-10.0	-26.5	0.66	45.	20.	0.0	0.47 0.58
2339	0.29	1.1	5.91	0.84	0.82	0.87	0.0154	-0.040	54.6	-10.0	-14.2					
2340	0.29	1.1	5.91	0.64	0.74	0.70	0.0465	-0.034	13.8	-10.0	-14.3	1.00	60.	20.	0.0	0.22 0.41
2341	0.29	1.1	5.99	0.84	0.88	0.89	0.0109	-0.041	76.7	-10.0	-14.1					
2342	0.29	1.1	5.99	0.61	0.63	1.02	0.1108	-0.074	5.5	-10.0	-14.3	1.40	60.	20.	0.0	0.31 0.69
2343	0.29	1.1	5.99	0.83	0.84	0.88	0.0102	-0.039	80.9	-15.0	-19.1					
2344	0.29	1.1	5.98	0.67	0.85	0.75	0.0430	-0.036	15.6	-15.0	-19.2	1.00	60.	20.	0.0	0.16 0.50
2345	0.29	1.1	5.97	0.87	0.95	0.91	0.0116	-0.042	74.8	-5.0	-9.1					
2346	0.28	1.1	5.97	0.62	0.68	0.62	0.0579	-0.030	10.7	-5.0	-9.1	1.00	60.	20.	0.0	0.28 0.56
2347	0.29	1.1	5.96	0.81	0.77	0.86	0.0110	-0.041	73.6	-5.0	-9.3					
2348	0.29	1.1	5.96	0.72	0.72	0.71	0.0436	-0.027	16.5	0.0	-4.3	1.00	60.	20.	0.0	BEAK ICE

APPENDIX D

NRC Clean Airfoil and Simulated Ice Test Data

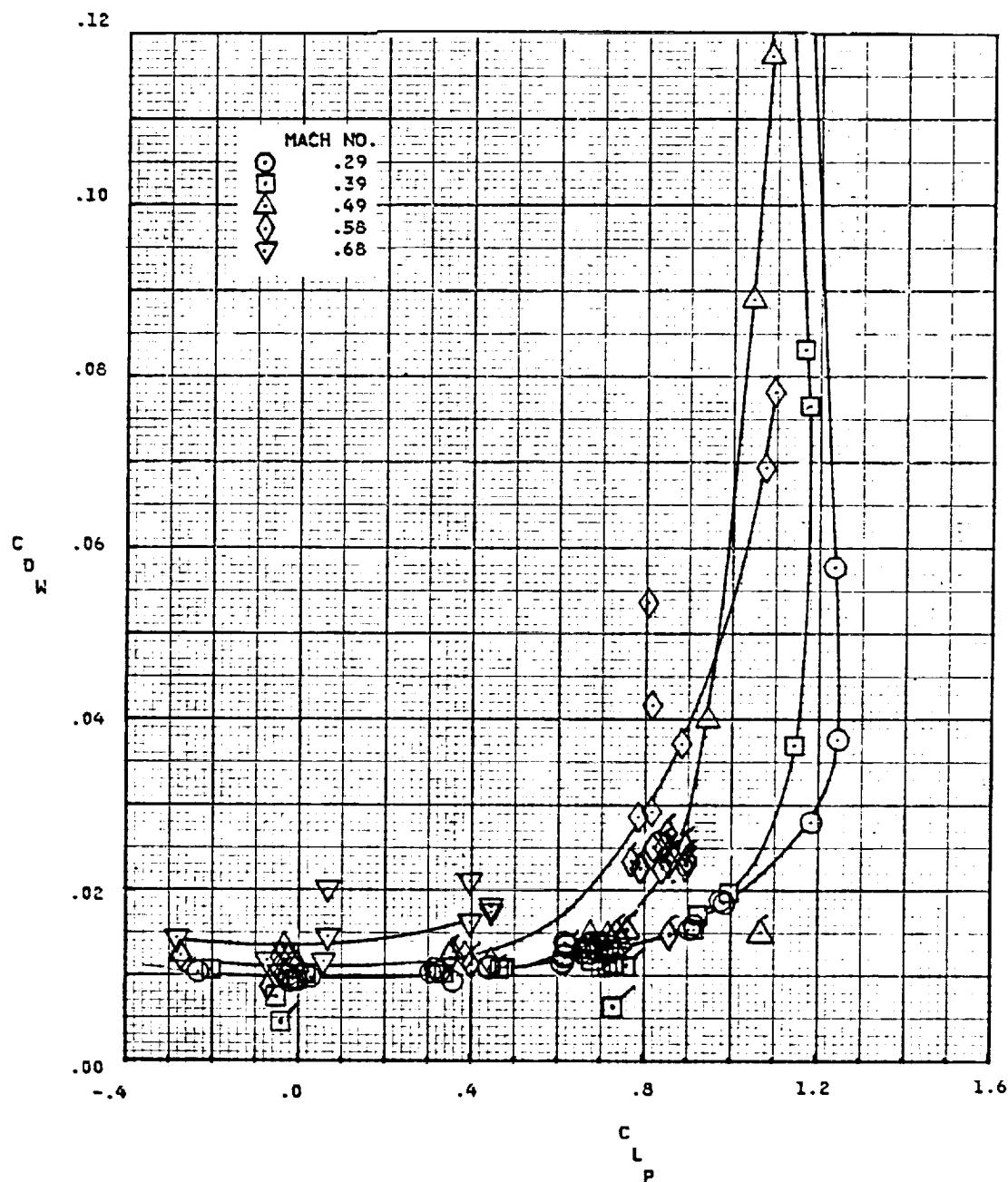
Figures D-1 through D-8 present the clean airfoil data acquired during the first and second phases of the NRC High Speed Icing Wind Tunnel tests. (The flagged symbols indicate Phase II data.) The data fairings shown on these figures were used as the clean airfoil baseline for the calculated icing incremental lift, drag, and pitching moment coefficients. Figures D-9 and D-10 present data for NACA 0012 airfoil and SSC-A09 airfoil simulated ice configurations. A wooden ice shape that reproduces the ice shape at blade station 10.5 of test "E" of reference 16, was bonded to the NACA 0012 model. Data from test of this configuration are given in Figure D-11.

ORIGINAL PAGE IS
OF POOR QUALITY



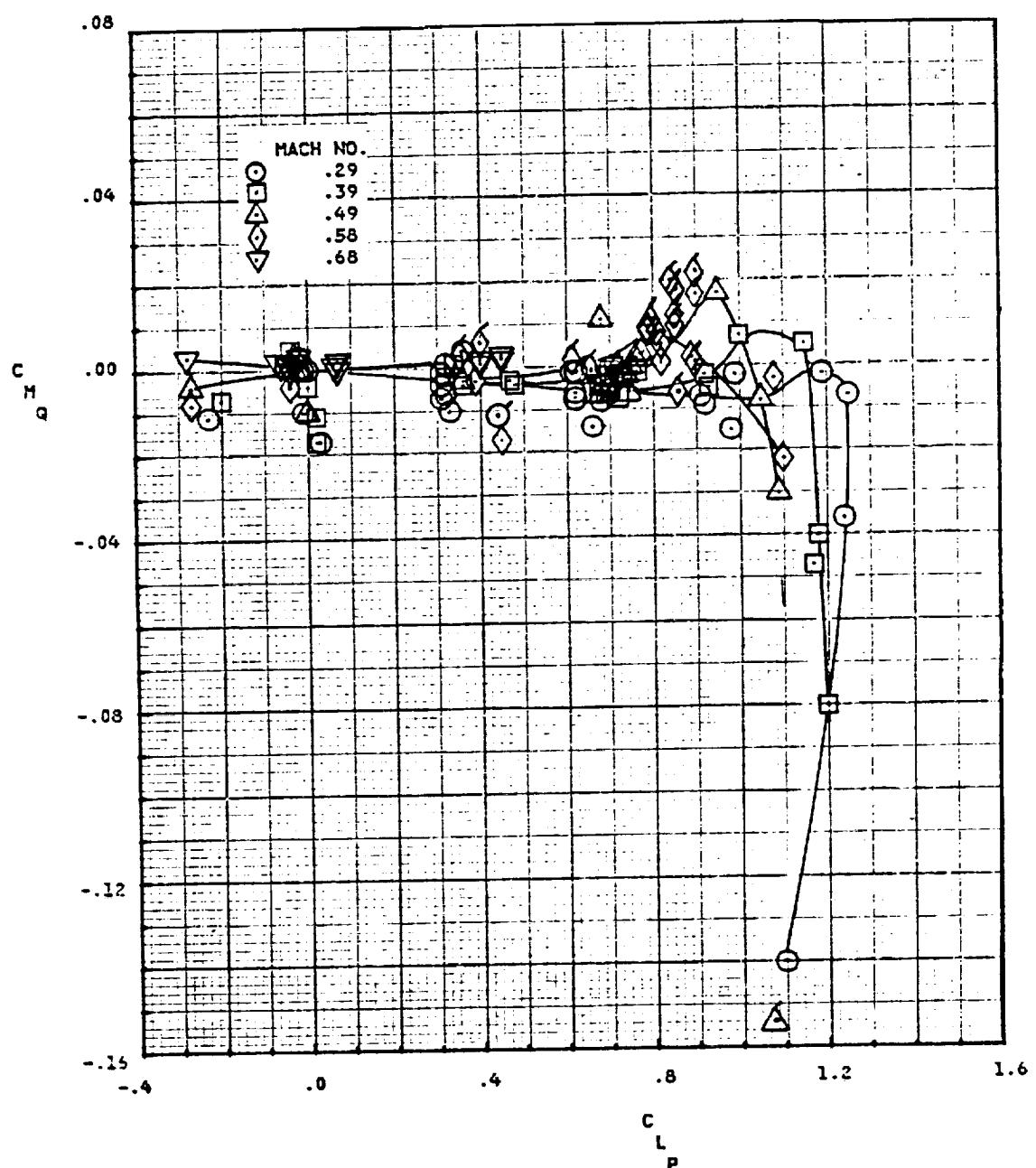
a. Lift coefficient versus angle of attack

Figure D-1. - Aerodynamic data for the clean NACA 0012 airfoil.



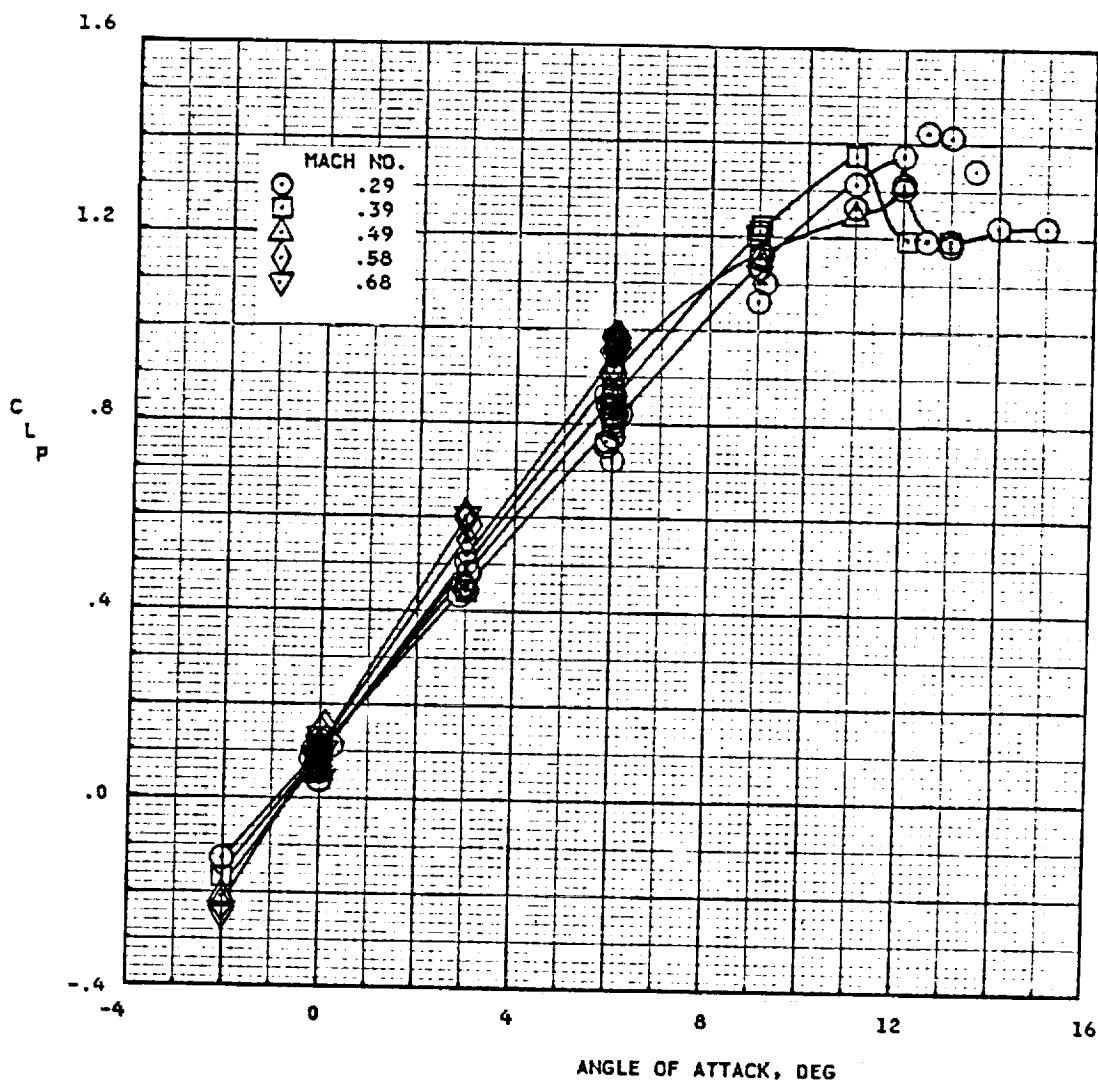
b. Drag coefficient versus lift coefficient

Figure D-1. - (Continued)



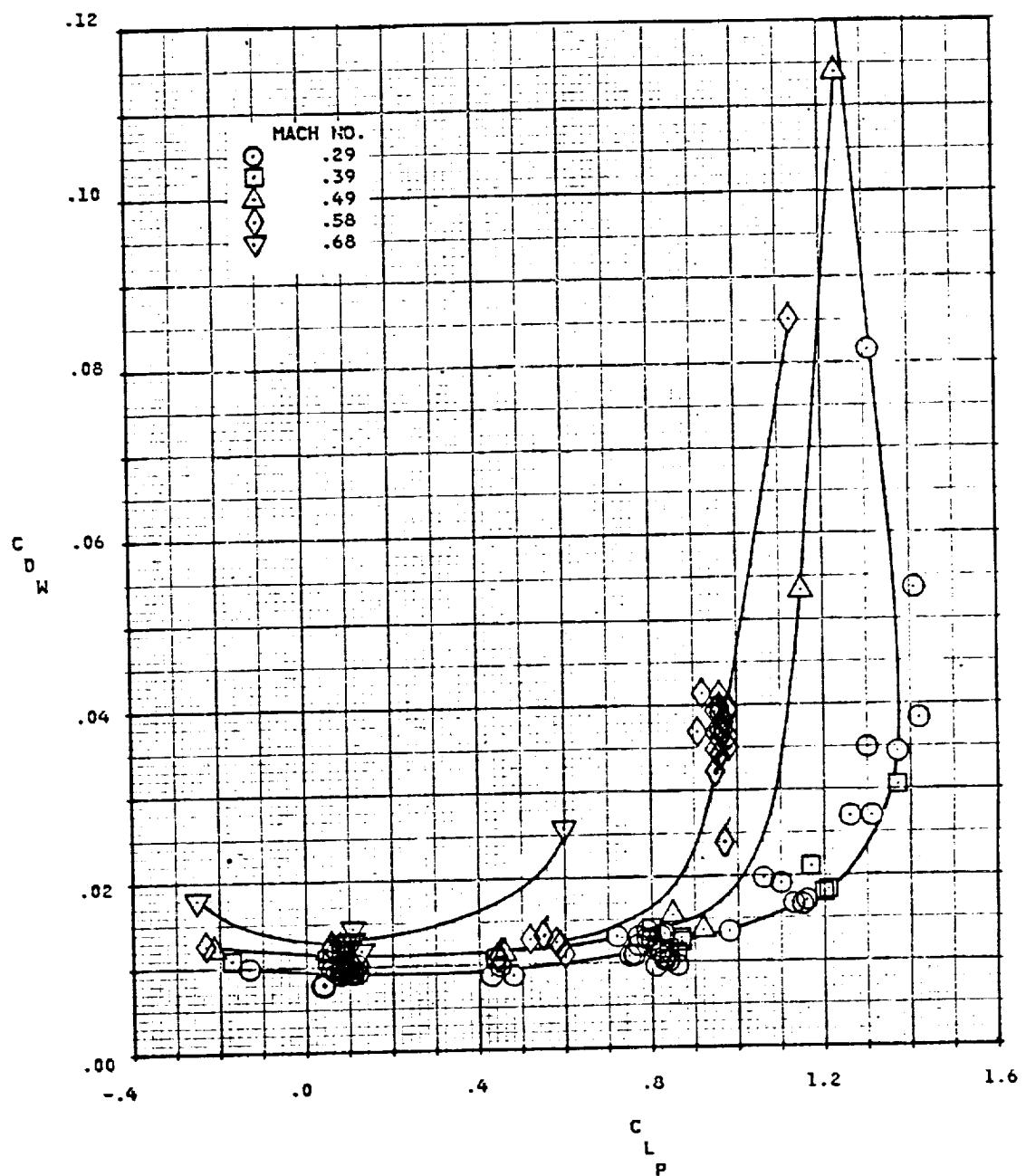
c. Pitching moment coefficient versus lift coefficient
Figure D-1. - (Concluded)

ORIGINAL PAGE IS
OF POOR QUALITY



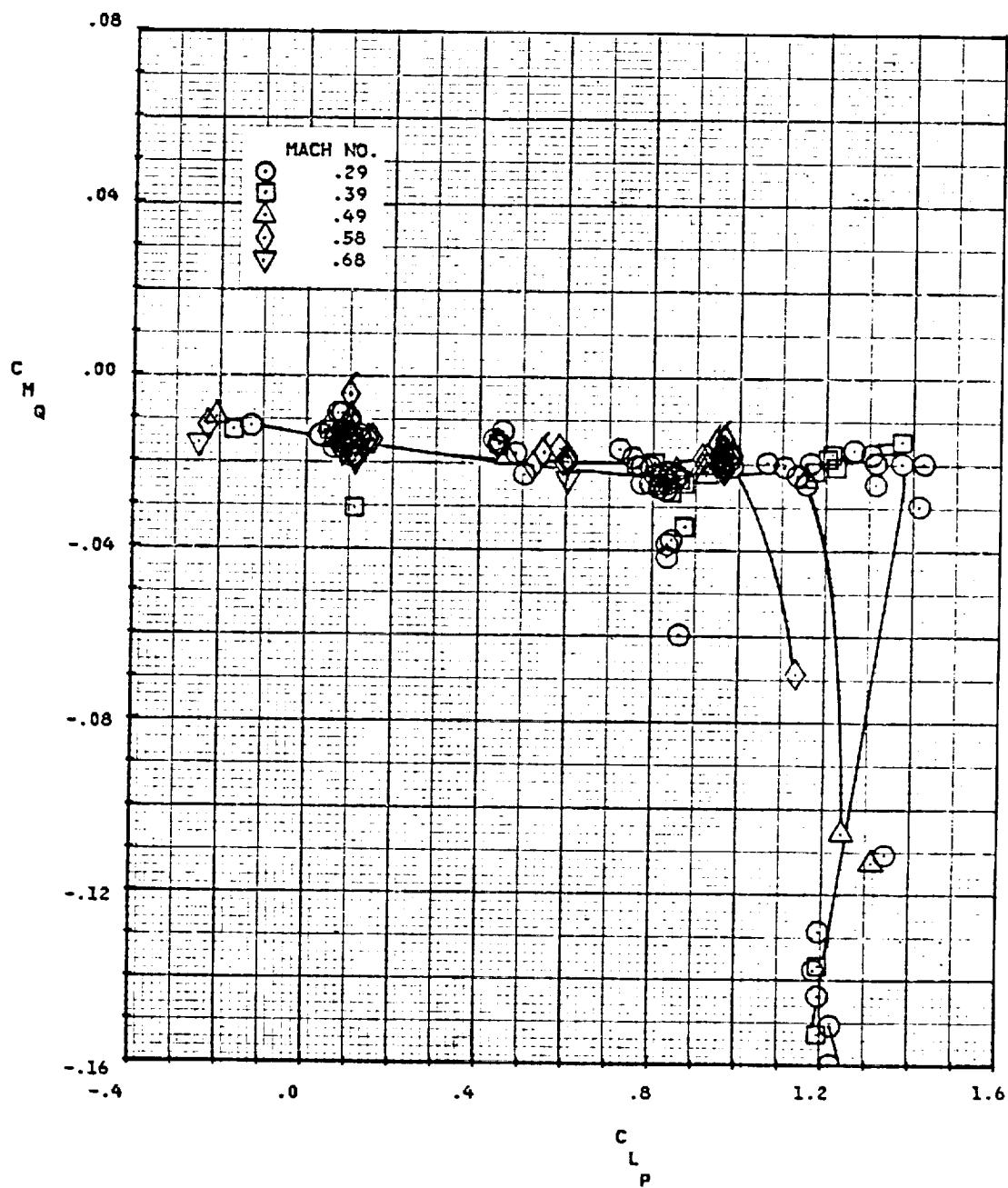
a. Lift coefficient versus angle of attack

Figure D-2. - Aerodynamic data for the clean SC1095 airfoil.

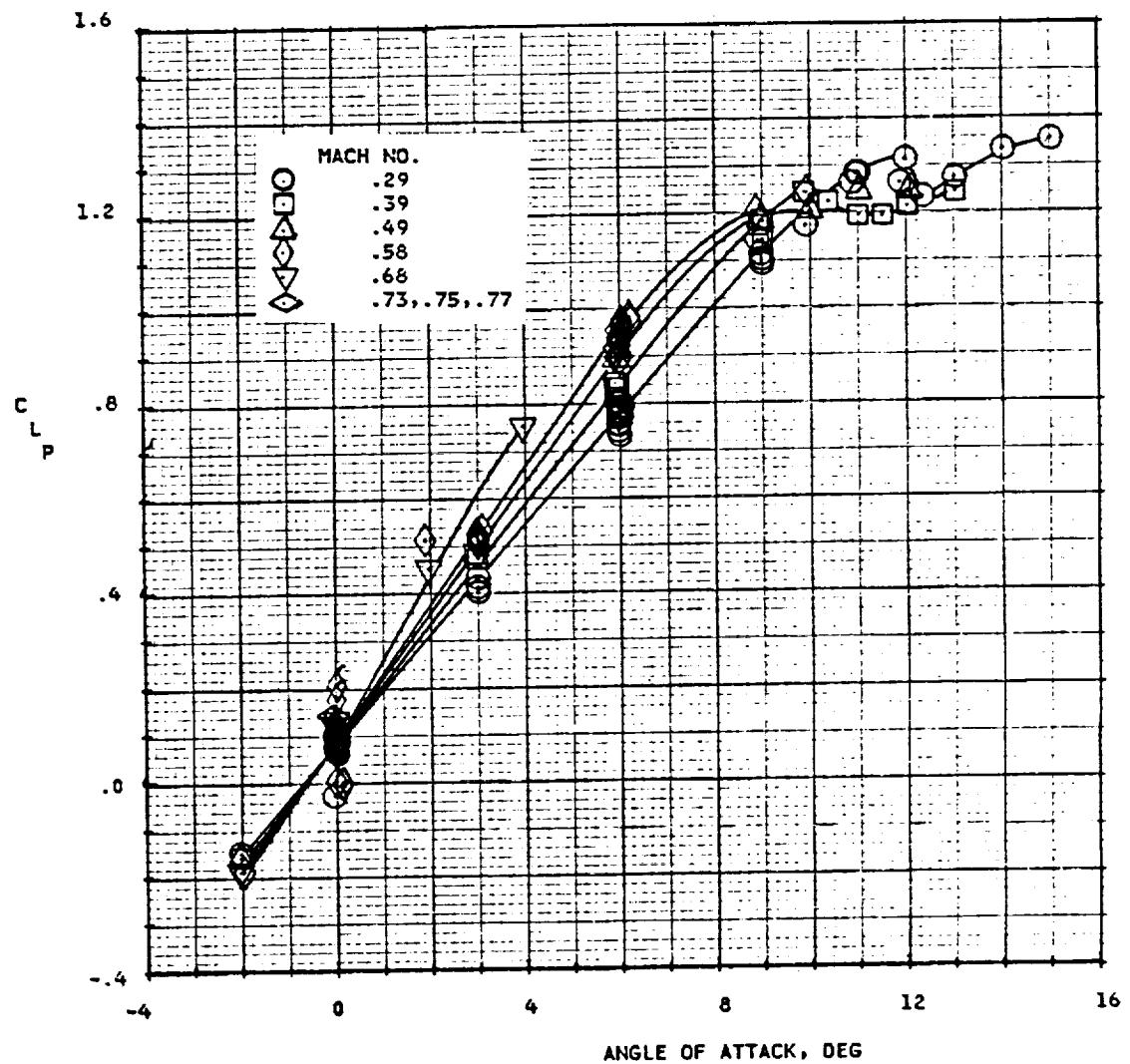


b. Drag coefficient versus lift coefficient
Figure D-2. (Continued)

ORIGINAL PAGE IS
OF POOR QUALITY



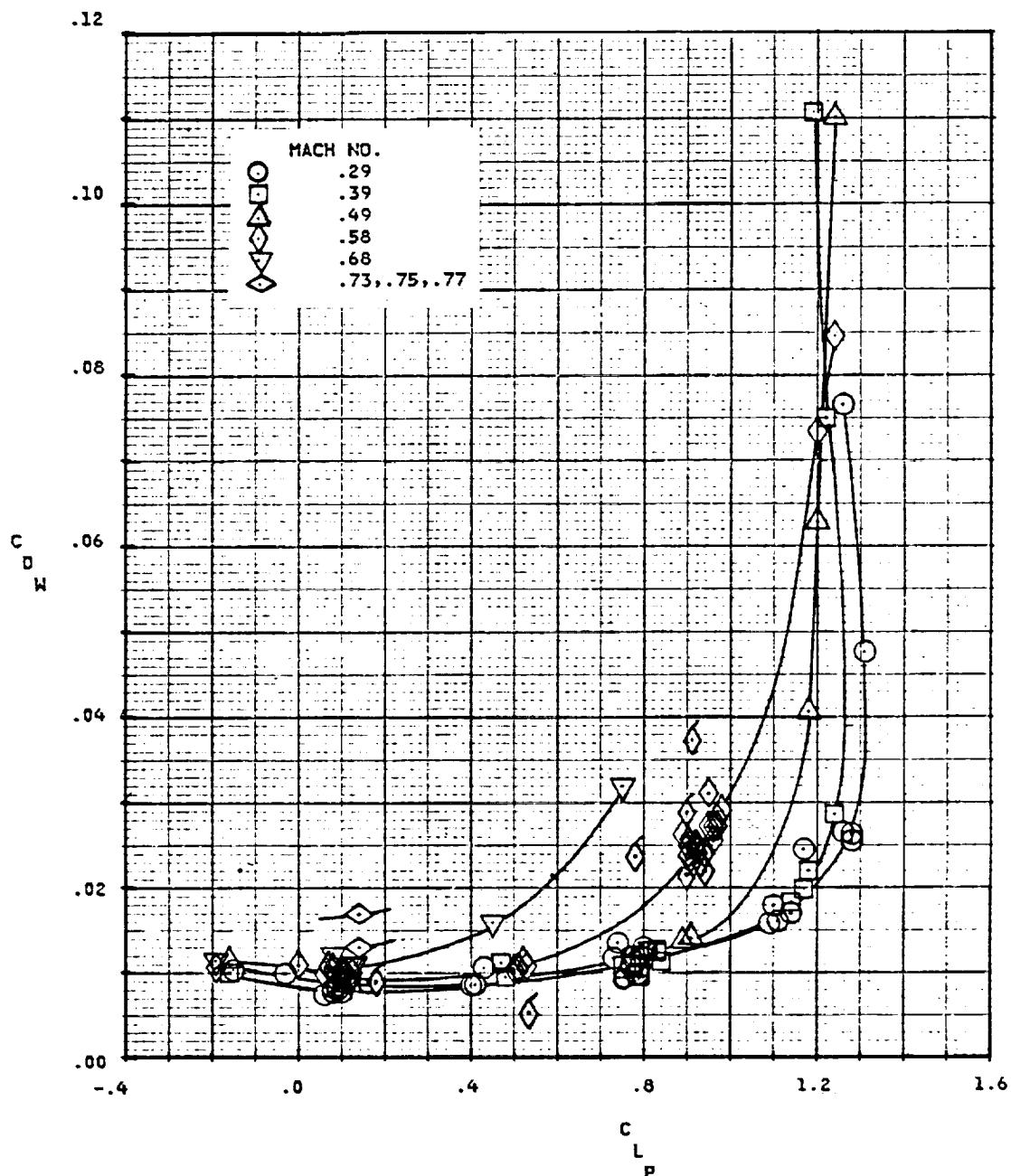
c. Pitching moment coefficient versus lift coefficient
Figure D-2. (Concluded)



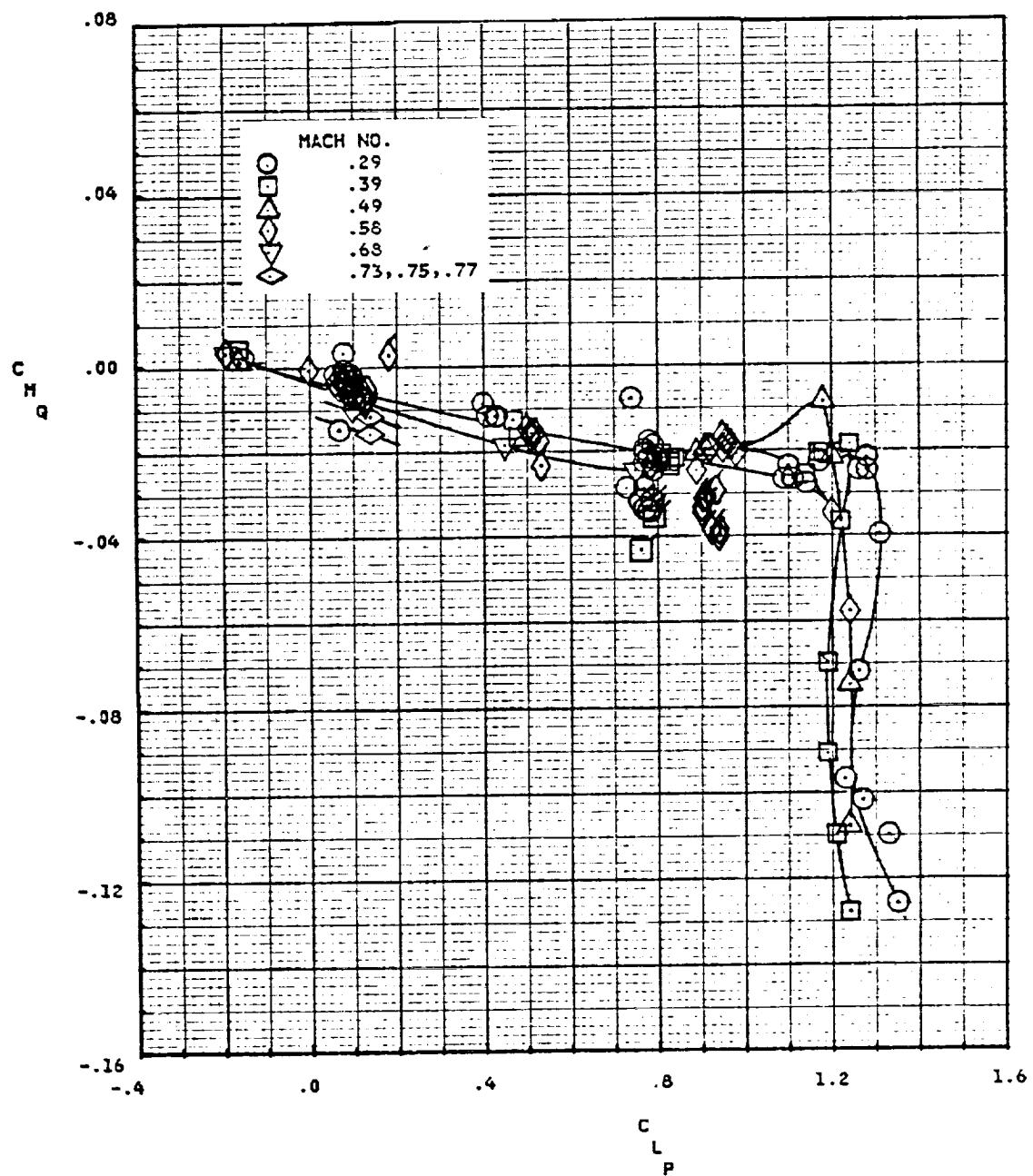
a. Lift coefficient versus angle of attack

Figure D-3. - Aerodynamic data for the clean SSC-A09 airfoil.

ORIGINAL PAGE IS
OF POOR QUALITY

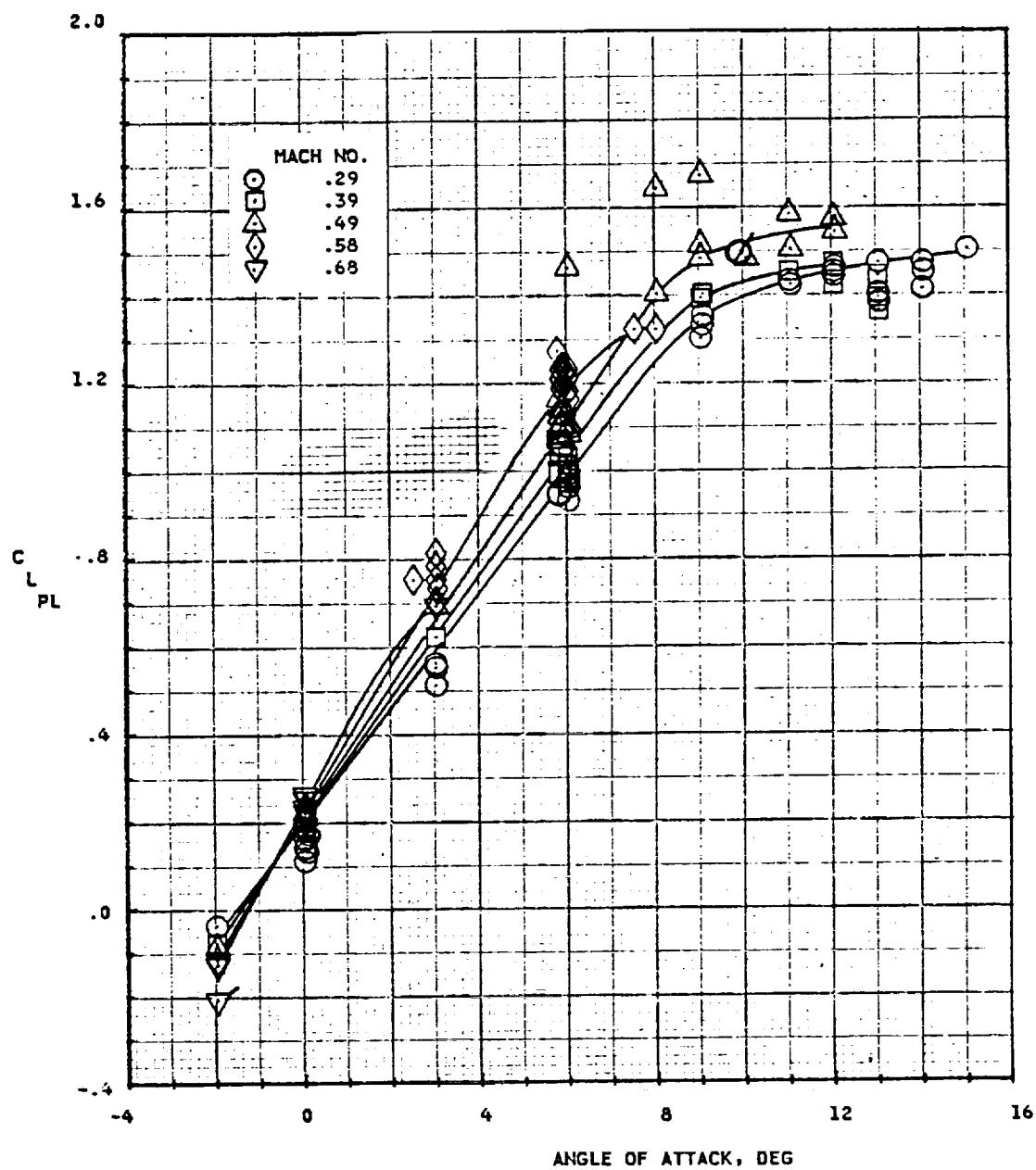


b. Drag coefficient versus lift coefficient
Figure D-3. (Continued)



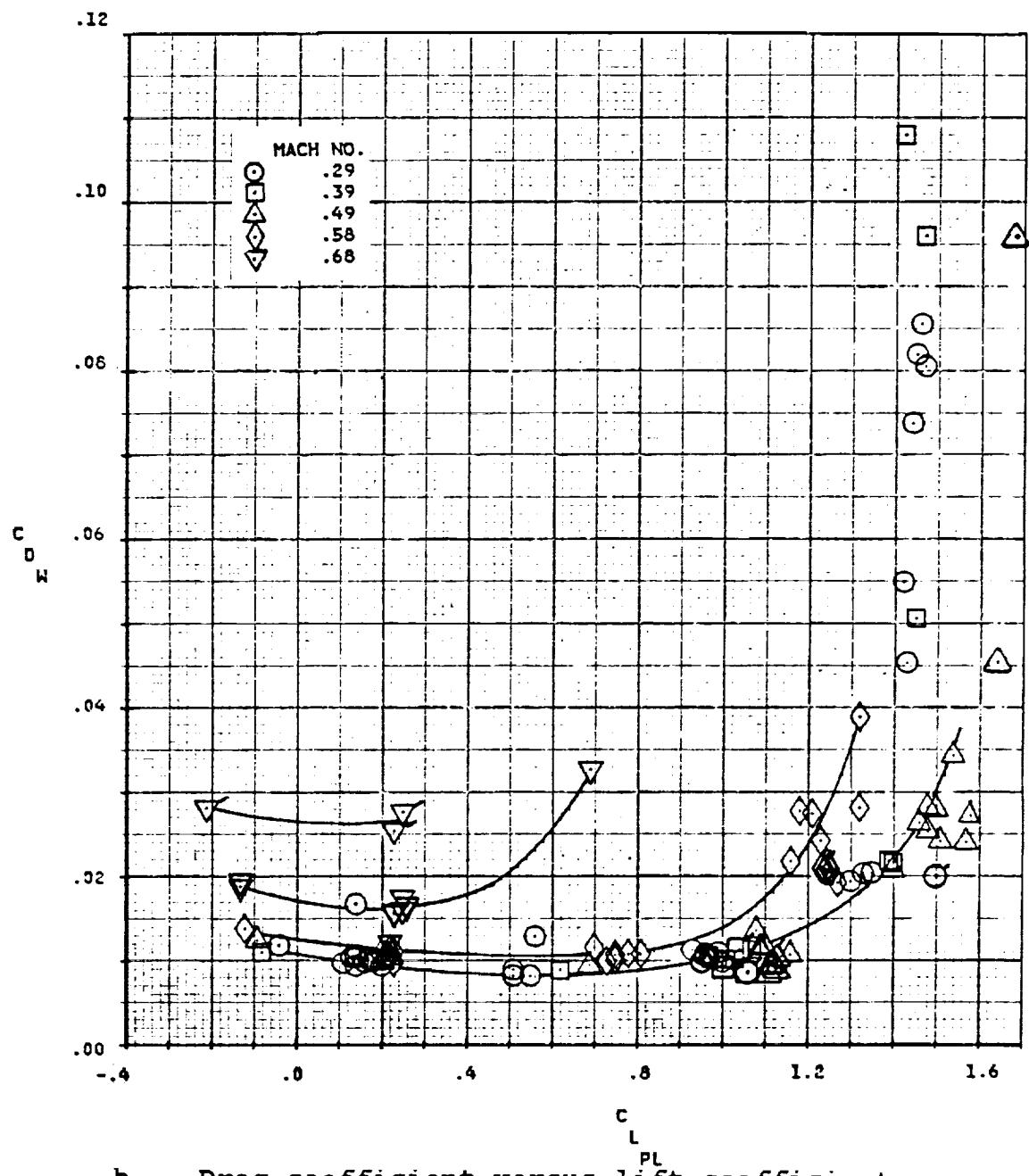
c. Pitching moment coefficient versus lift coefficient
 Figure D-3. (Concluded)

ORIGINAL PAGE IS
OF POOR QUALITY

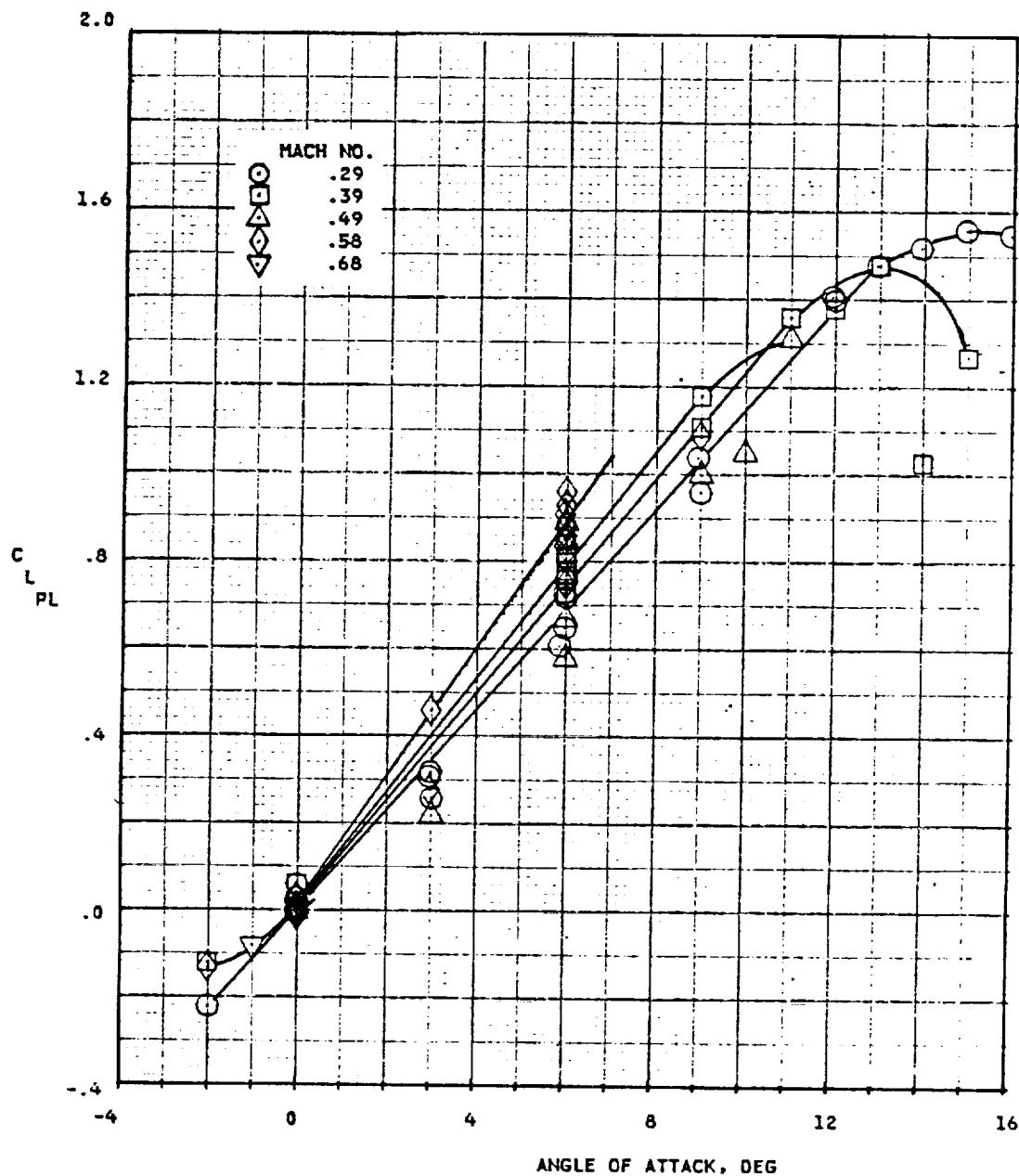


a. Lift coefficient versus angle of attack

Figure D-4. - Aerodynamic data for the clean VR-7 airfoil.

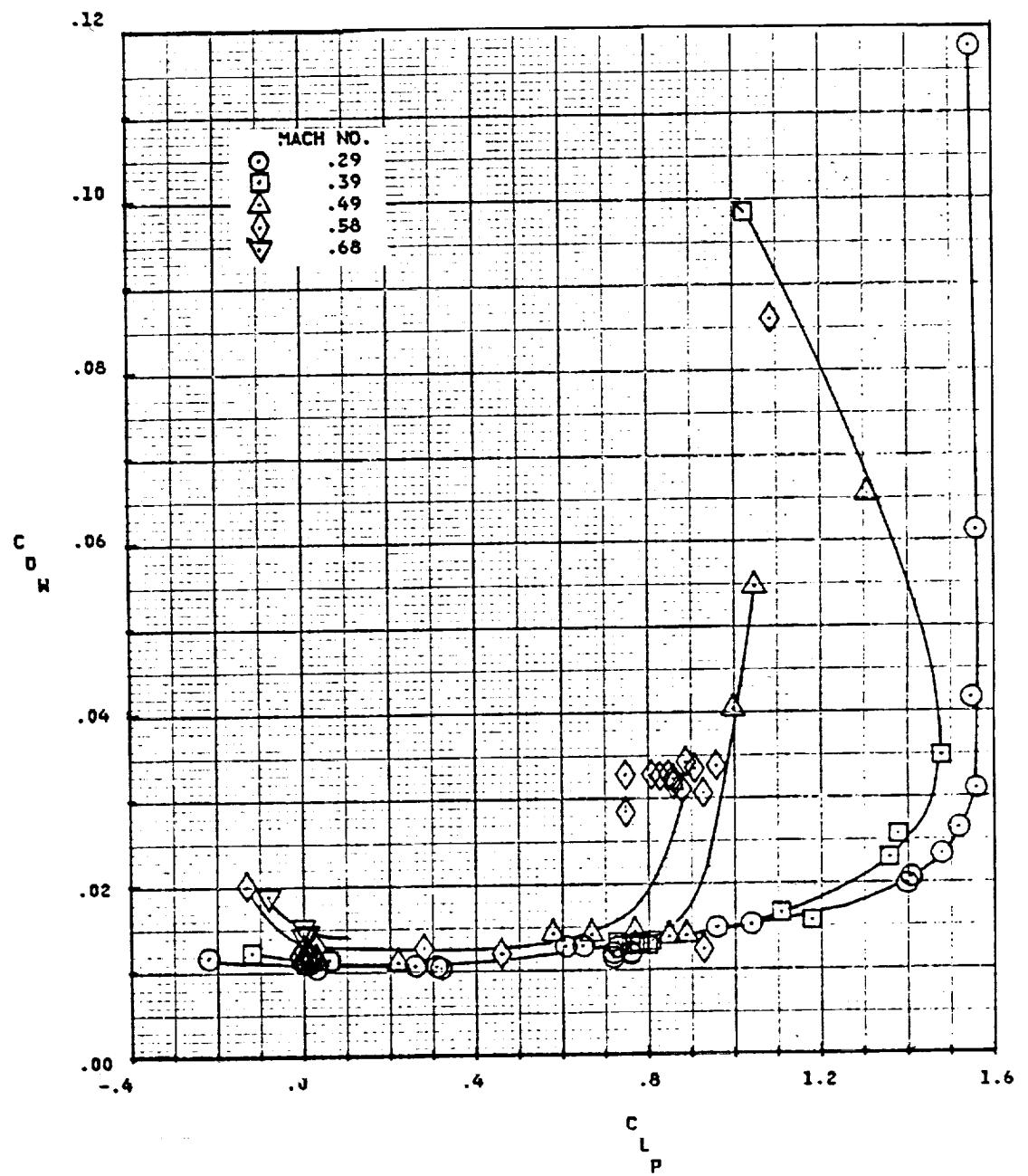


ORIGINAL PAGE IS
OF POOR QUALITY



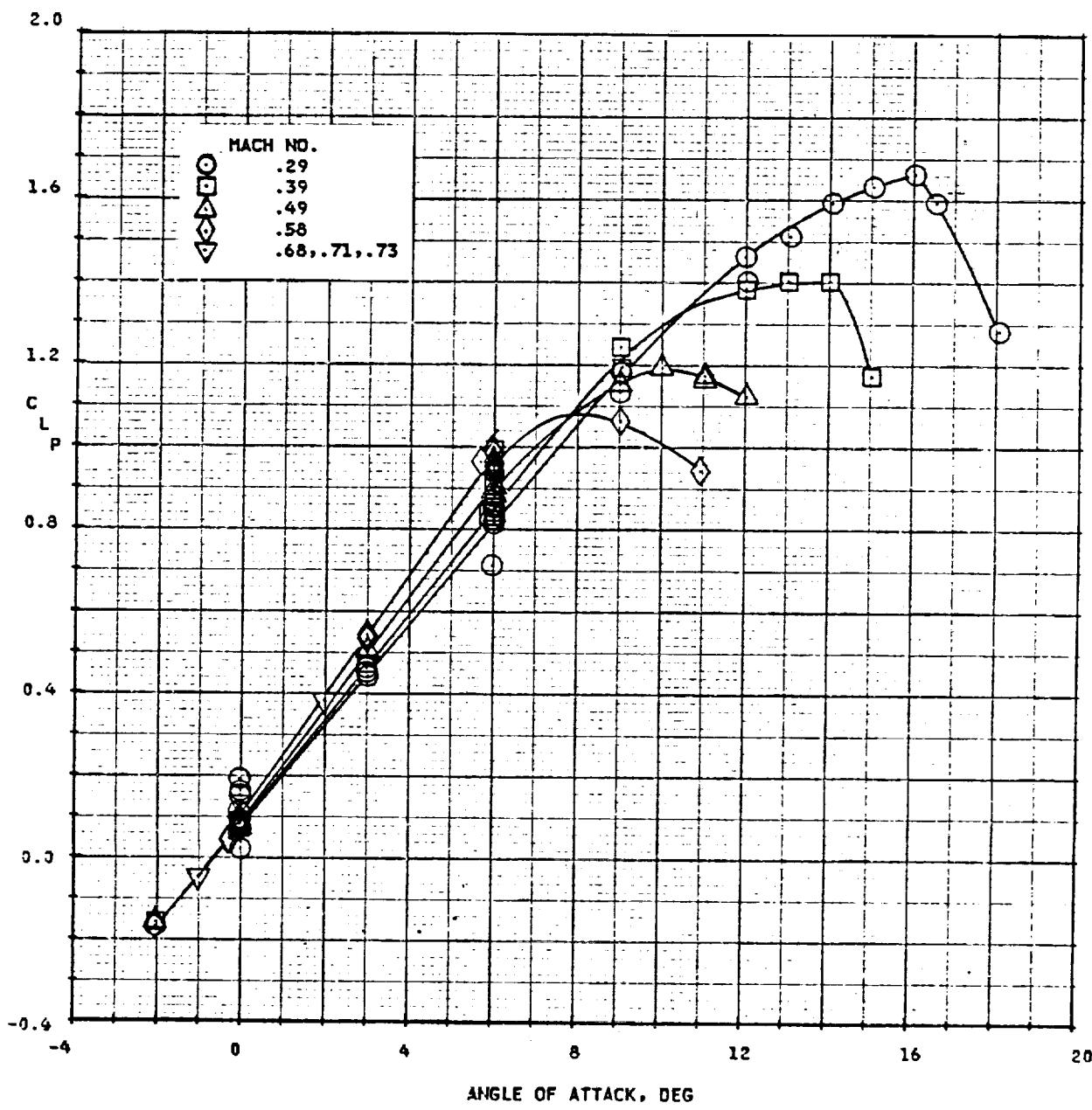
a. Lift coefficient versus angle of attack

Figure D-5. - Aerodynamic data for the clean SC1094 R8 airfoil.



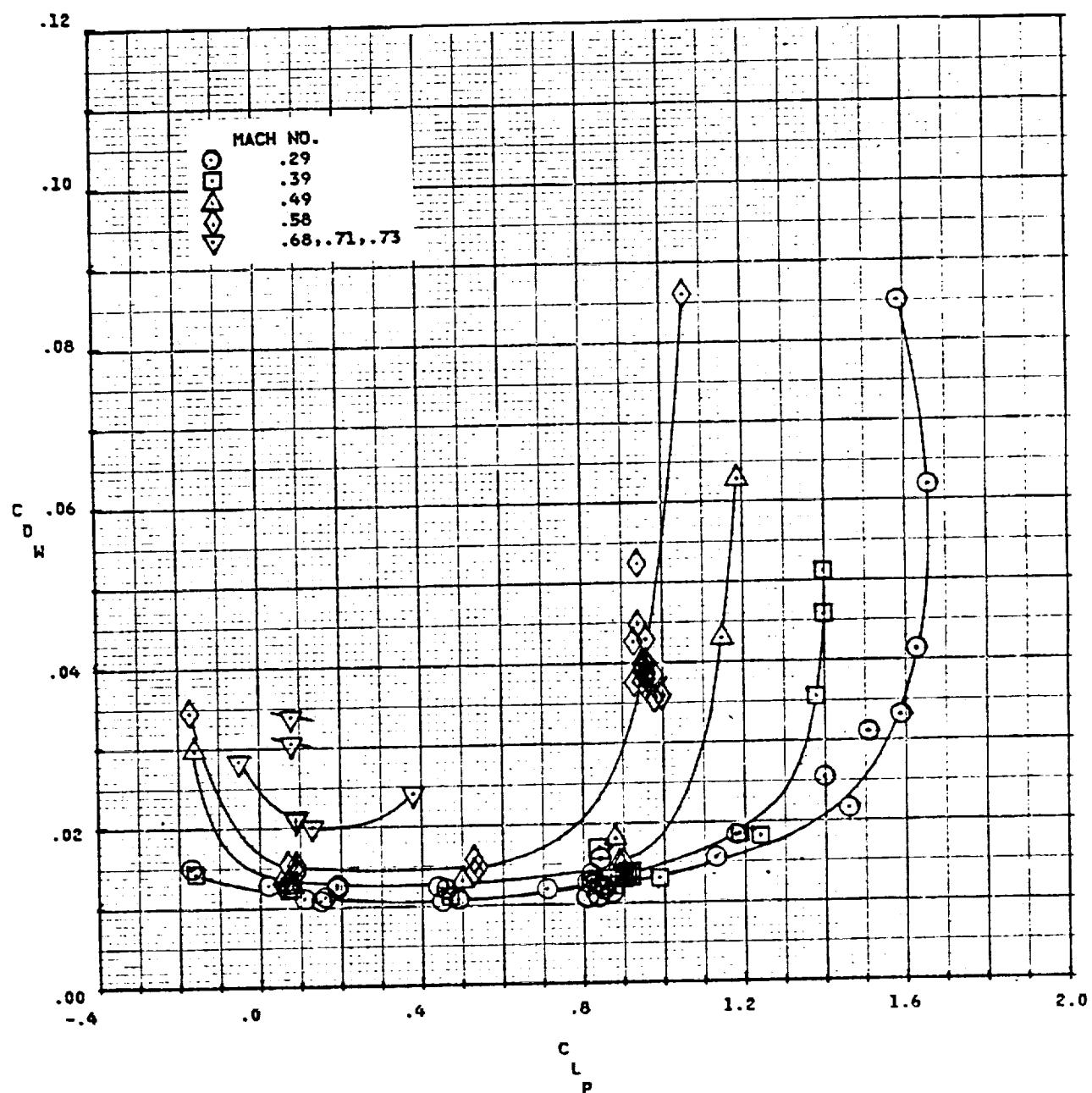
b. Drag coefficient versus lift coefficient
Figure D-5. (Concluded)

ORIGINAL PAGE IS
OF POOR QUALITY.



a. Lift coefficient versus angle of attack

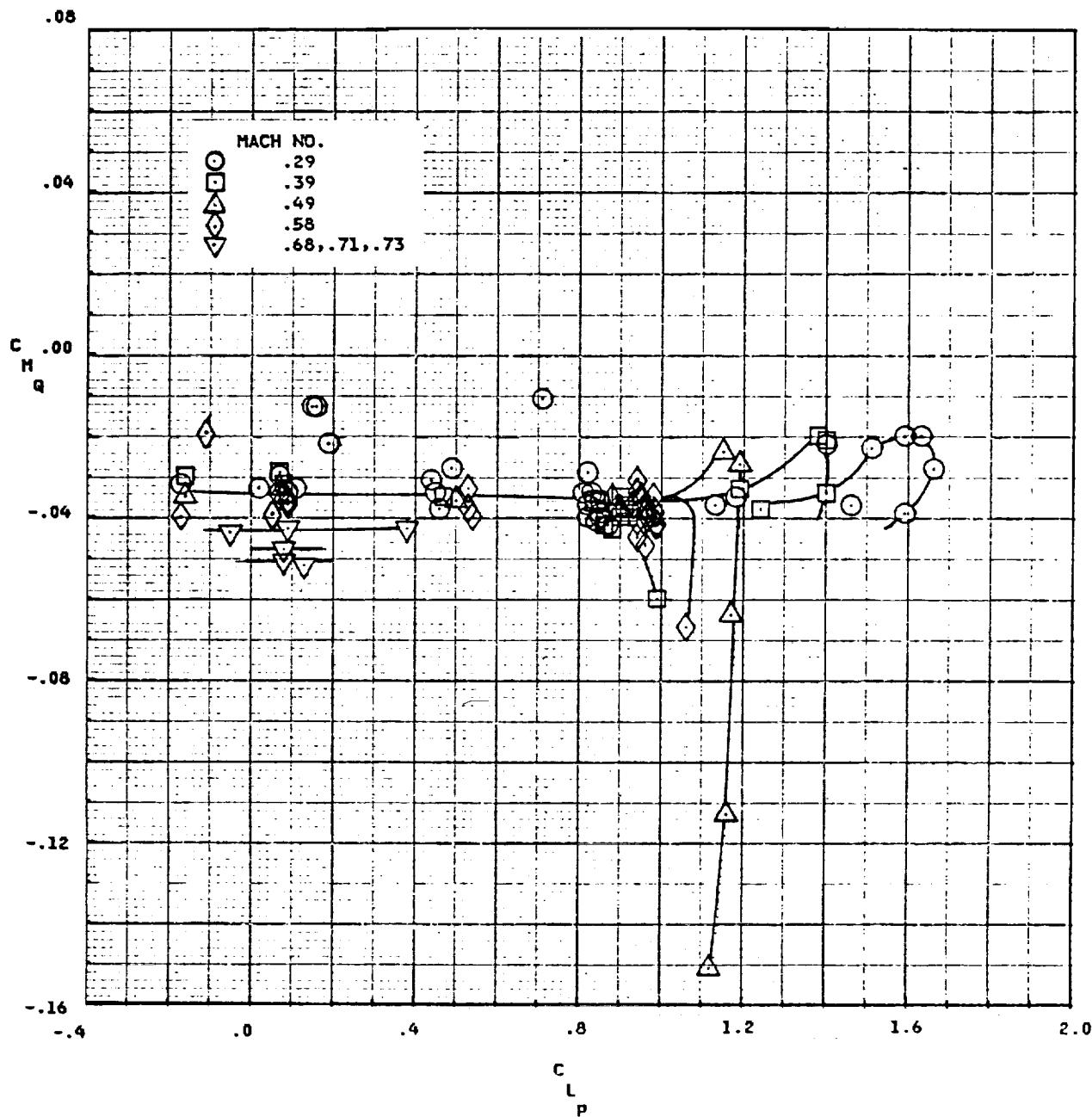
Figure D-6. - Aerodynamic data for the clean SC1012 R8 airfoil.

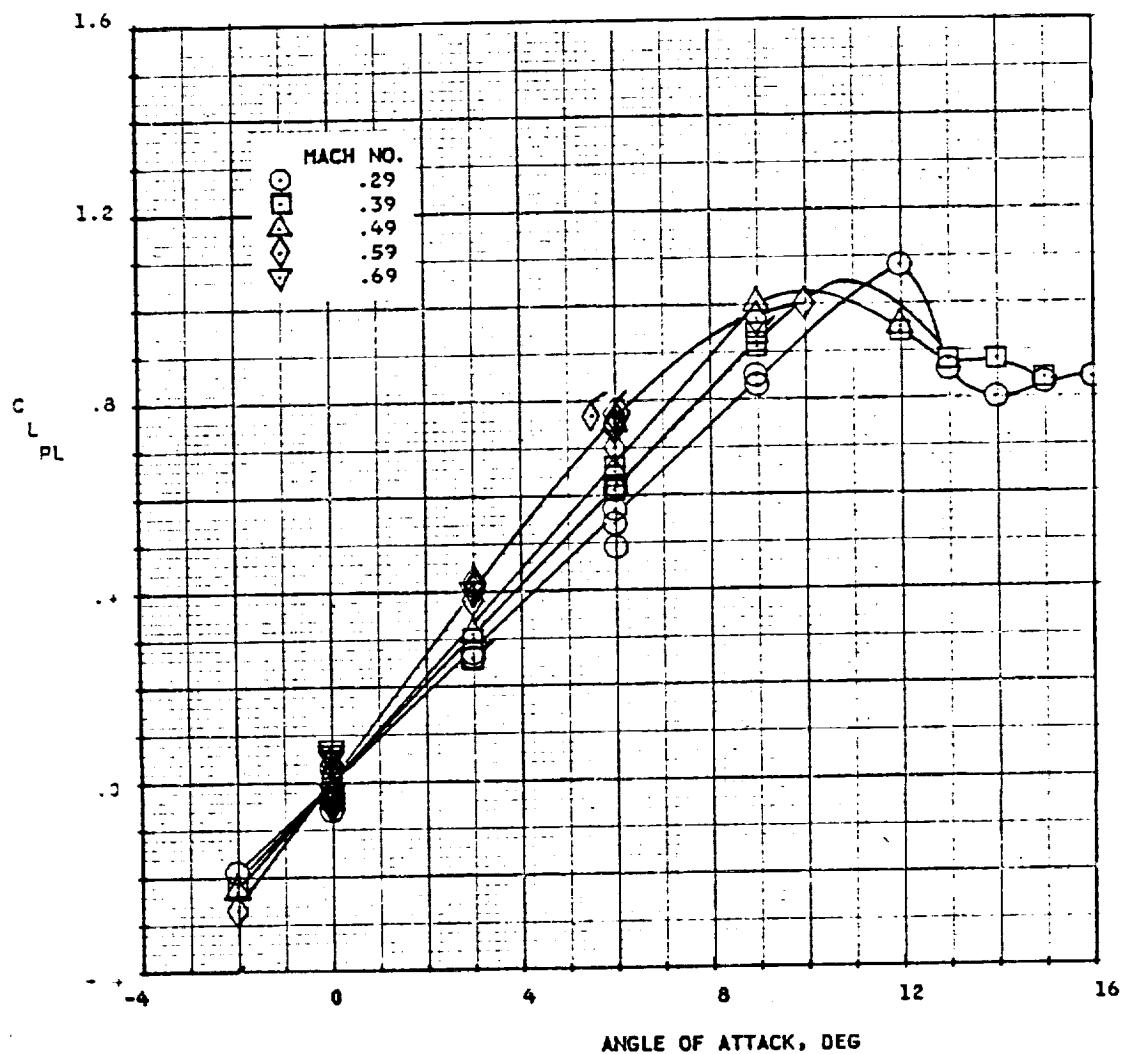


b. Drag coefficient versus lift coefficient

Figure D-6. — (Continued)

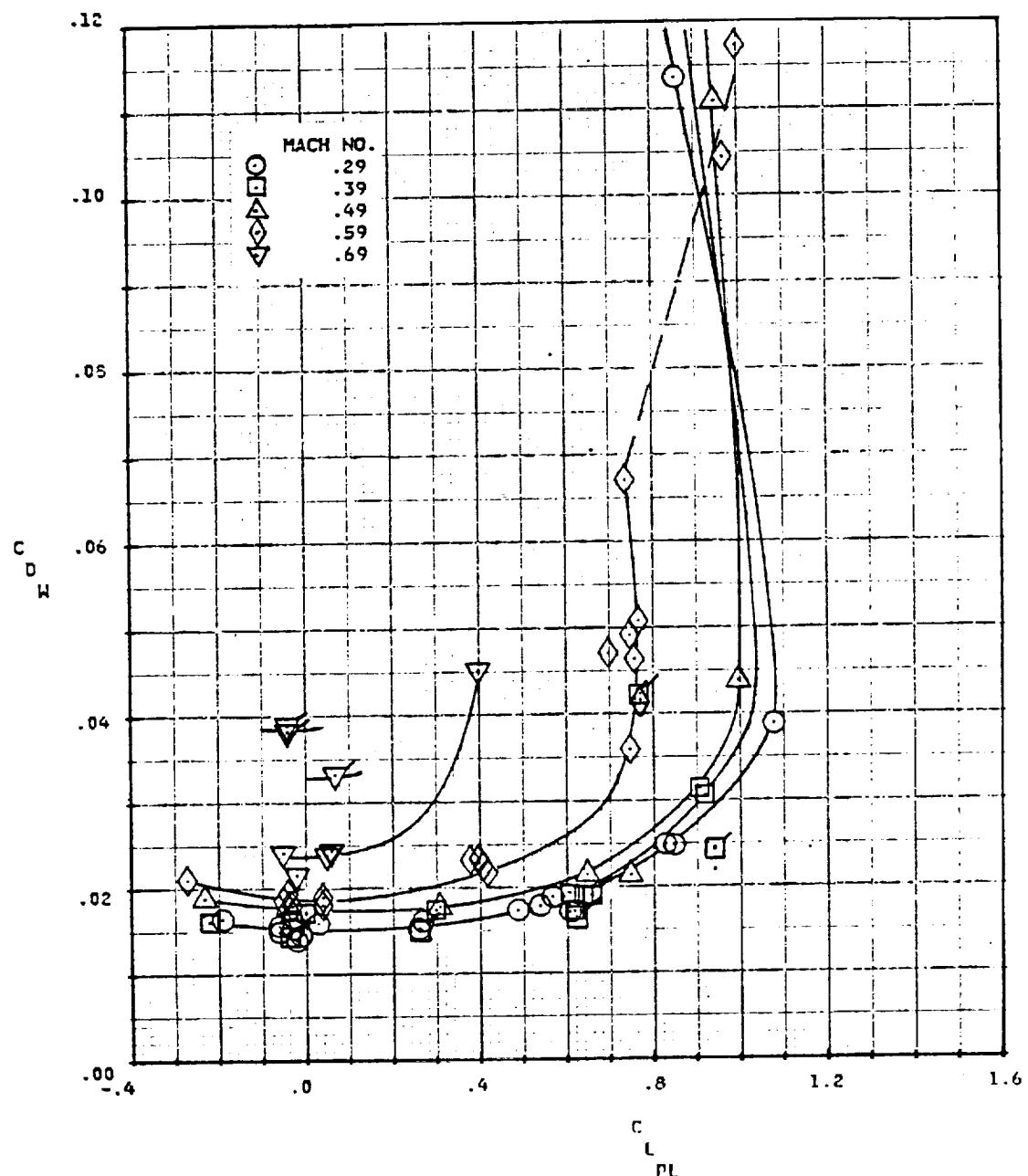
ORIGINAL PAGE IS
OF POOR QUALITY





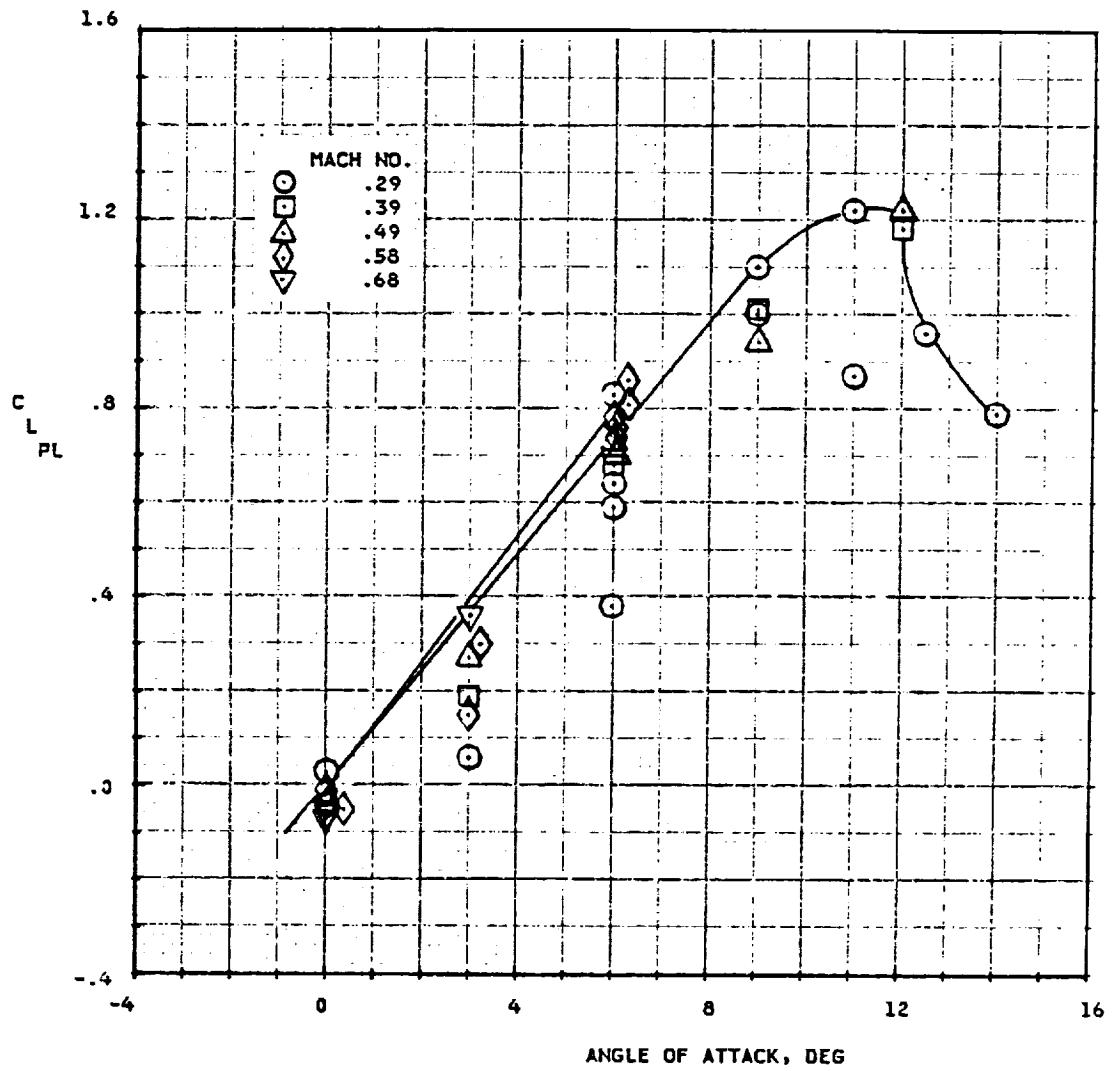
a. Lift coefficient versus angle of attack

Figure D-7. - Aerodynamic data for the clean OH-58 tail rotor blade.



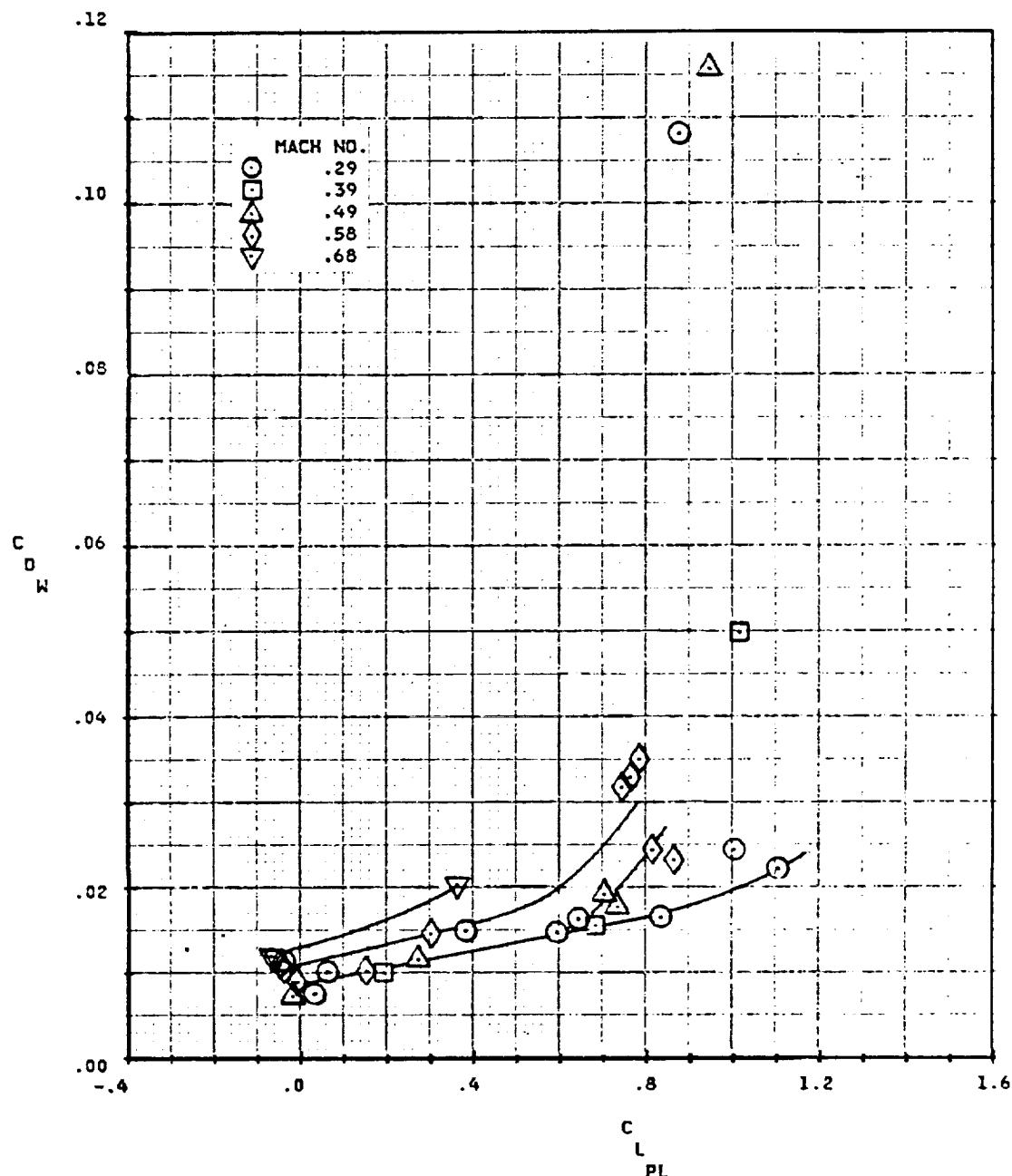
b. Drag coefficient versus lift coefficient

Figure D-7. (Concluded)

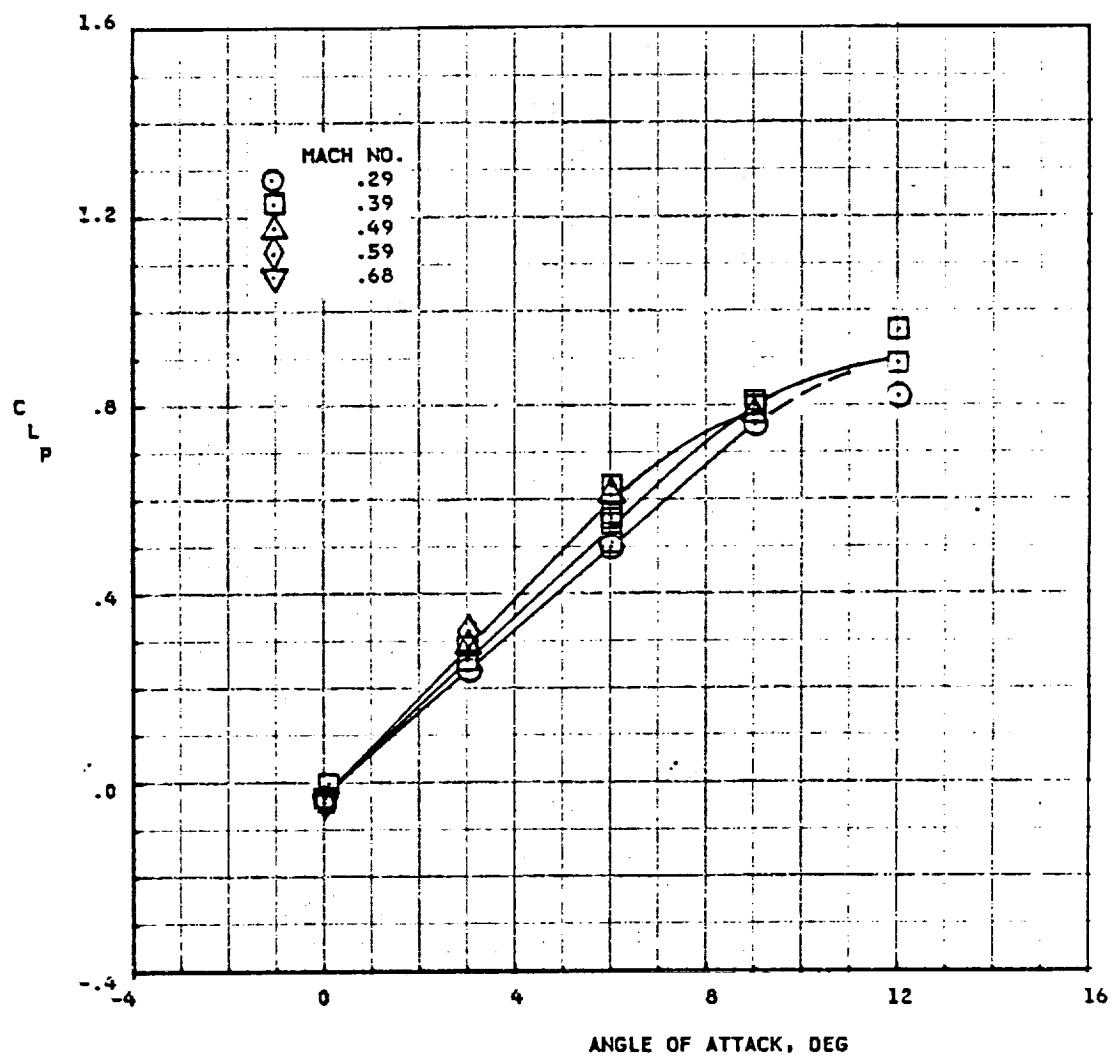


a. Lift coefficient versus angle of attack

Figure D-8. - Aerodynamic data for the clean NACA 0011.5 model H-34 rotor blade.



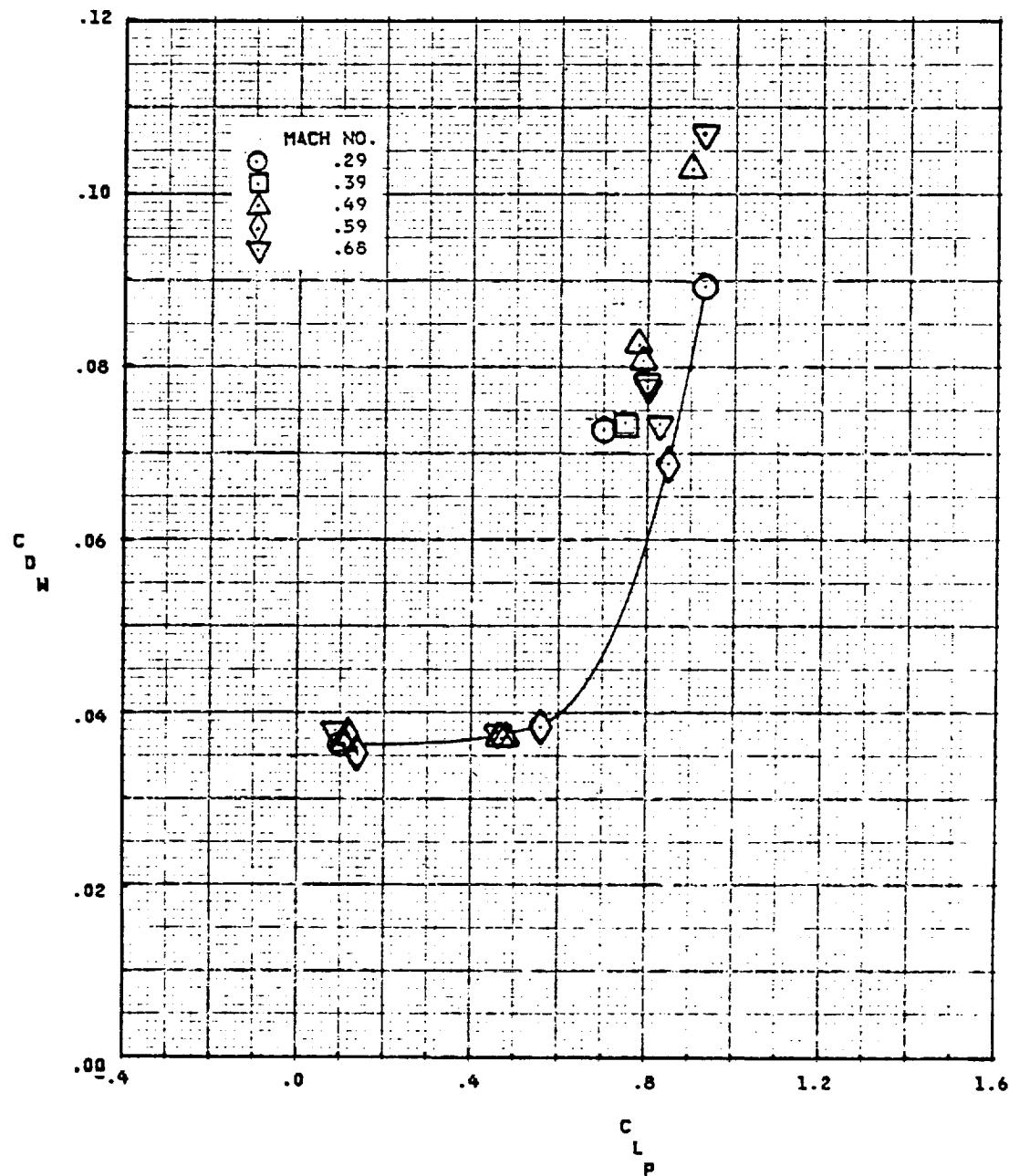
b. Drag coefficient versus lift coefficient
 Figure D-8. (Concluded)

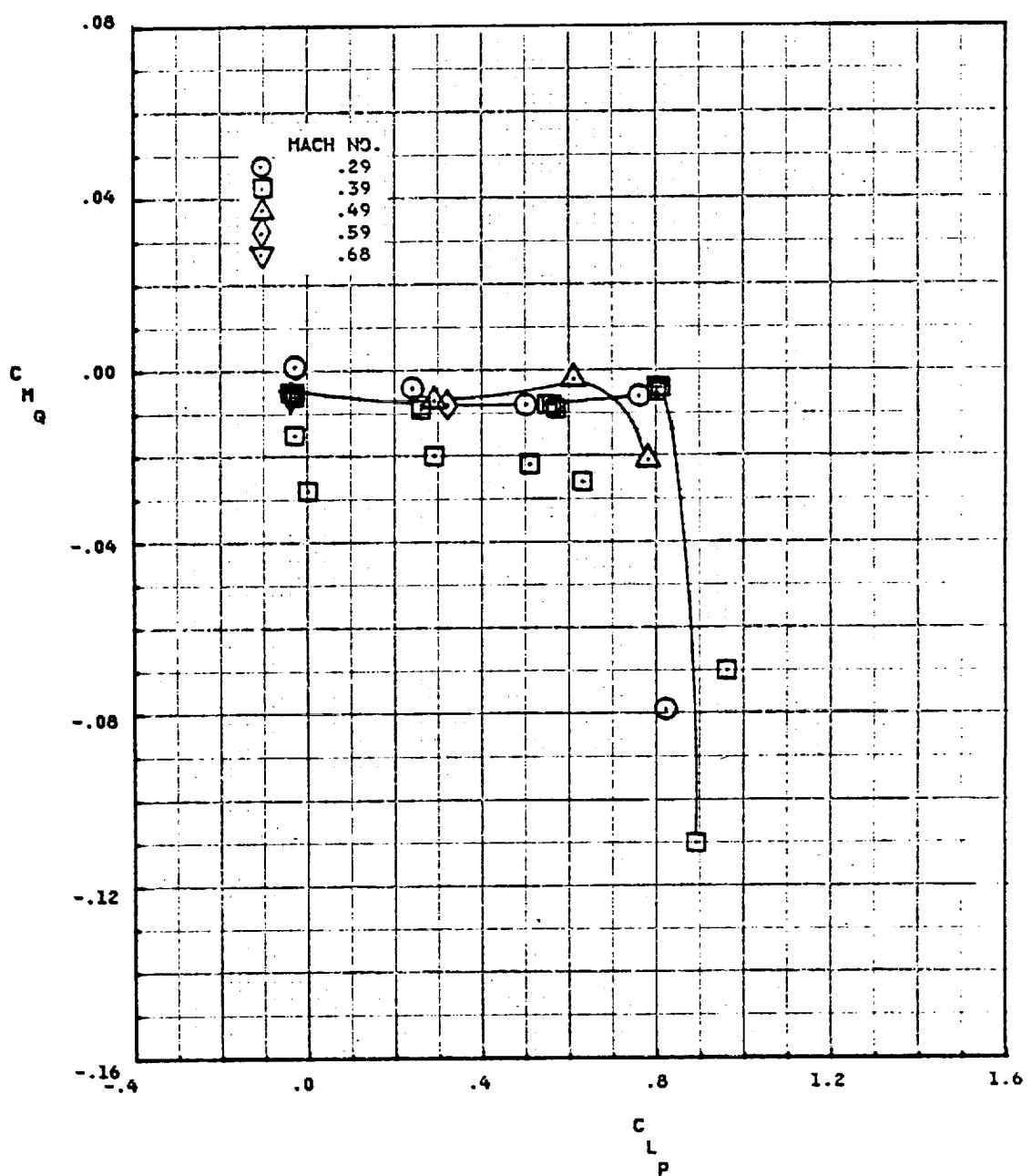


a. Lift coefficient versus angle of attack

Figure D-9. - Aerodynamic data for the NACA 0012 airfoil with simulated ice number 2, NRC Phase II test.

ORIGINAL PAGE IS
OF POOR QUALITY

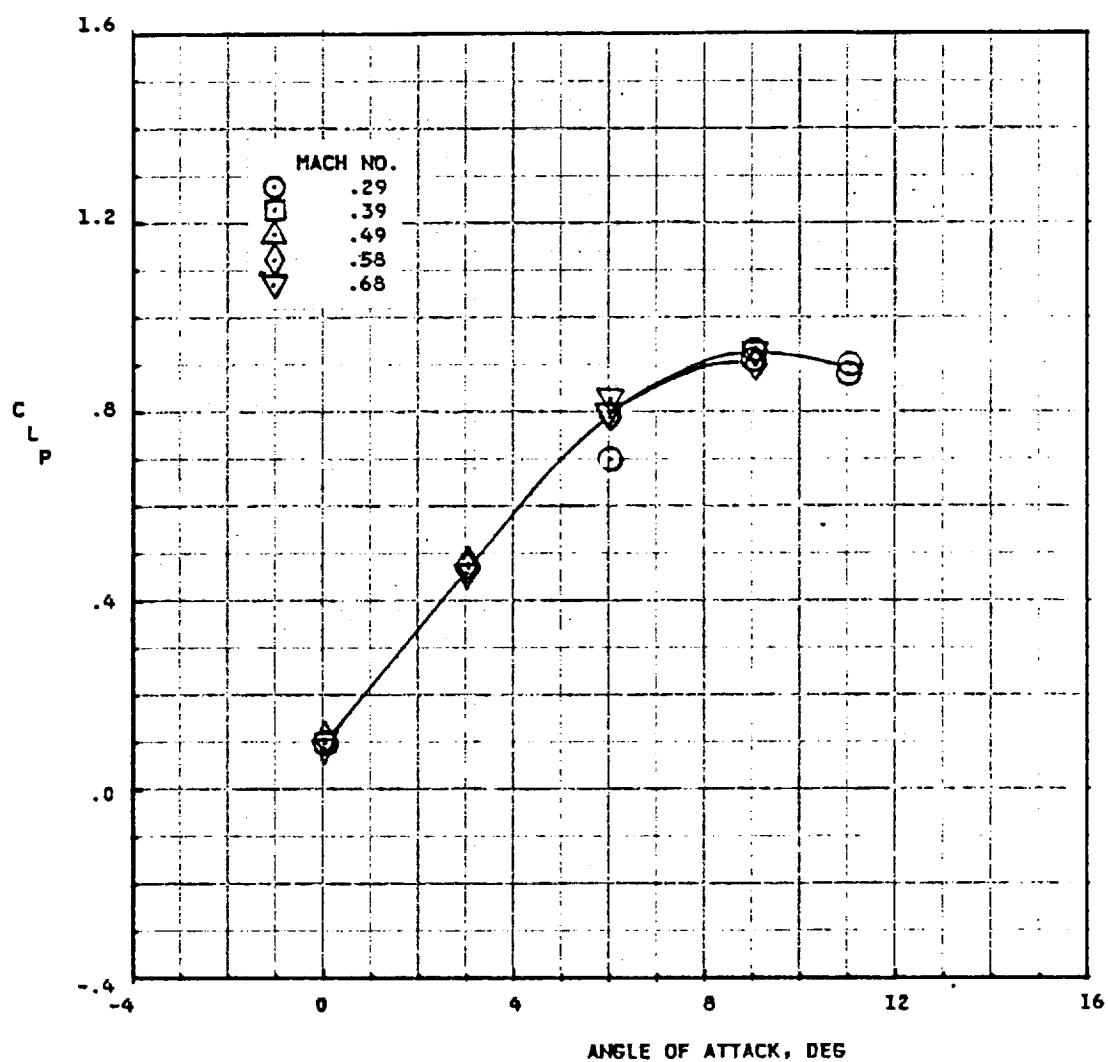




c. Pitching moment coefficient versus lift coefficient

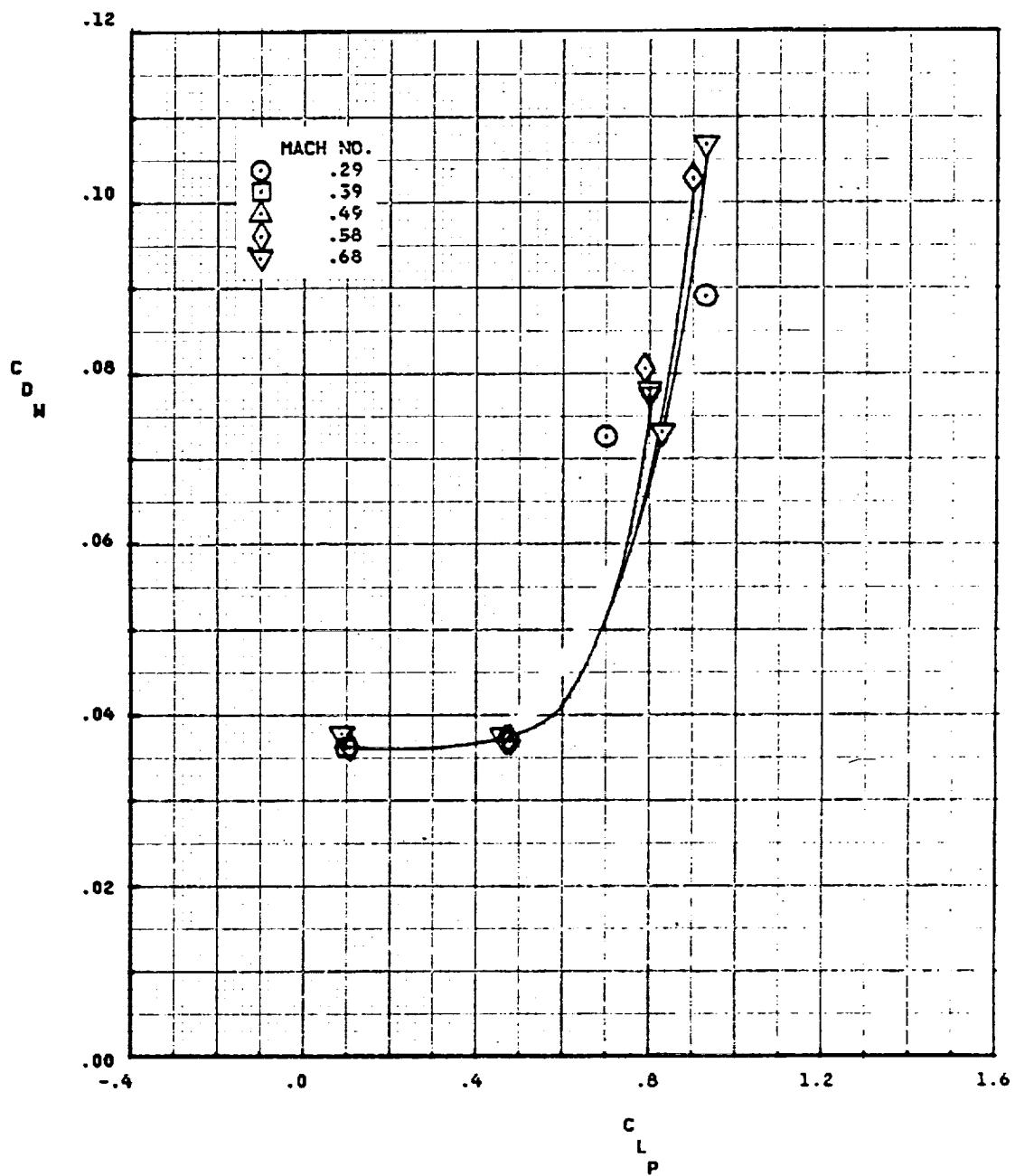
Figure D-9. - (Concluded)

ORIGINAL PAGE IS
OF POOR QUALITY



a. Lift coefficient versus angle of attack

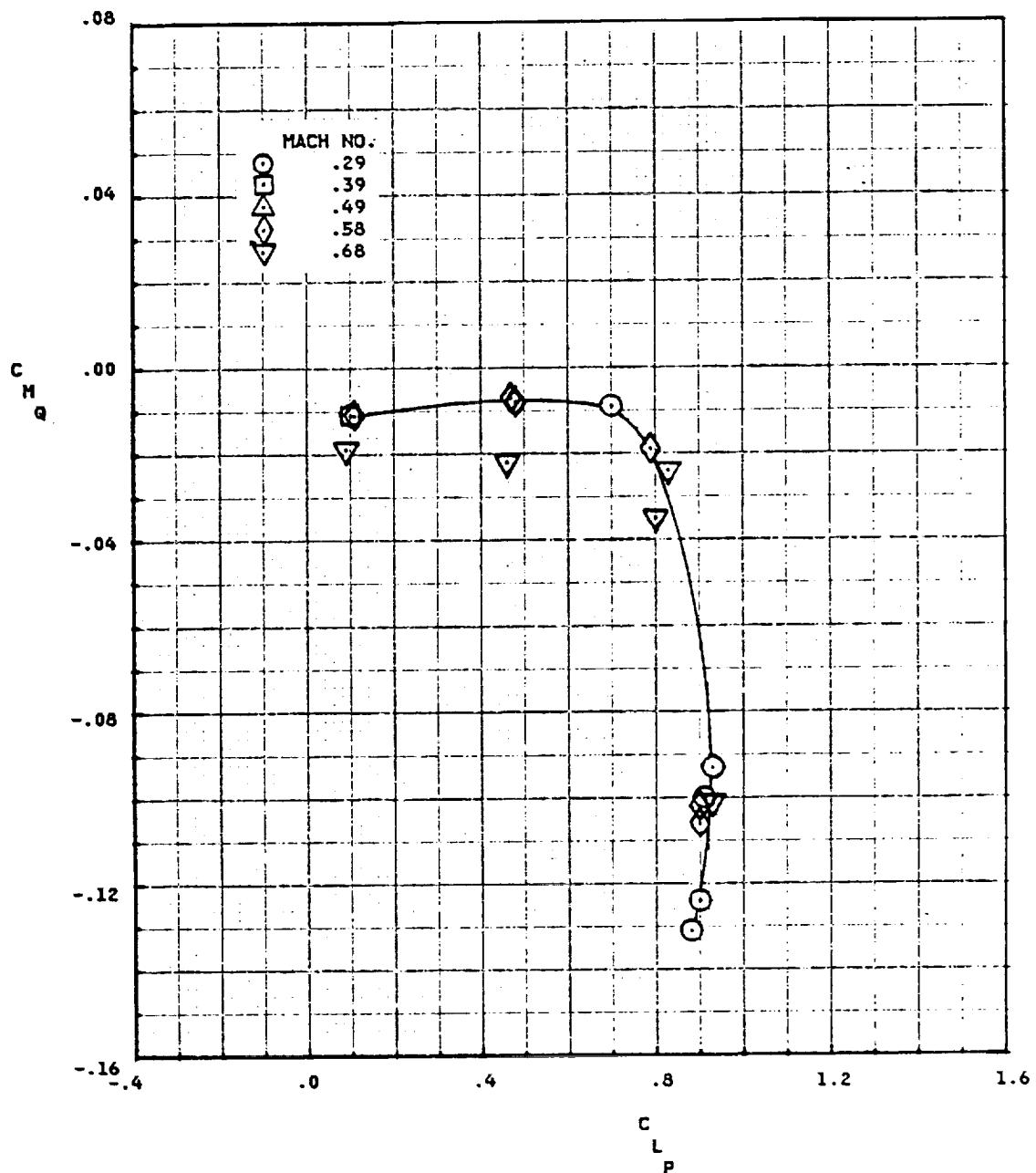
Figure D-10. - Aerodynamic data for the SSC-A09 airfoil with simulated ice number 2, NRC Phase II test.



b. Drag coefficient versus lift coefficient

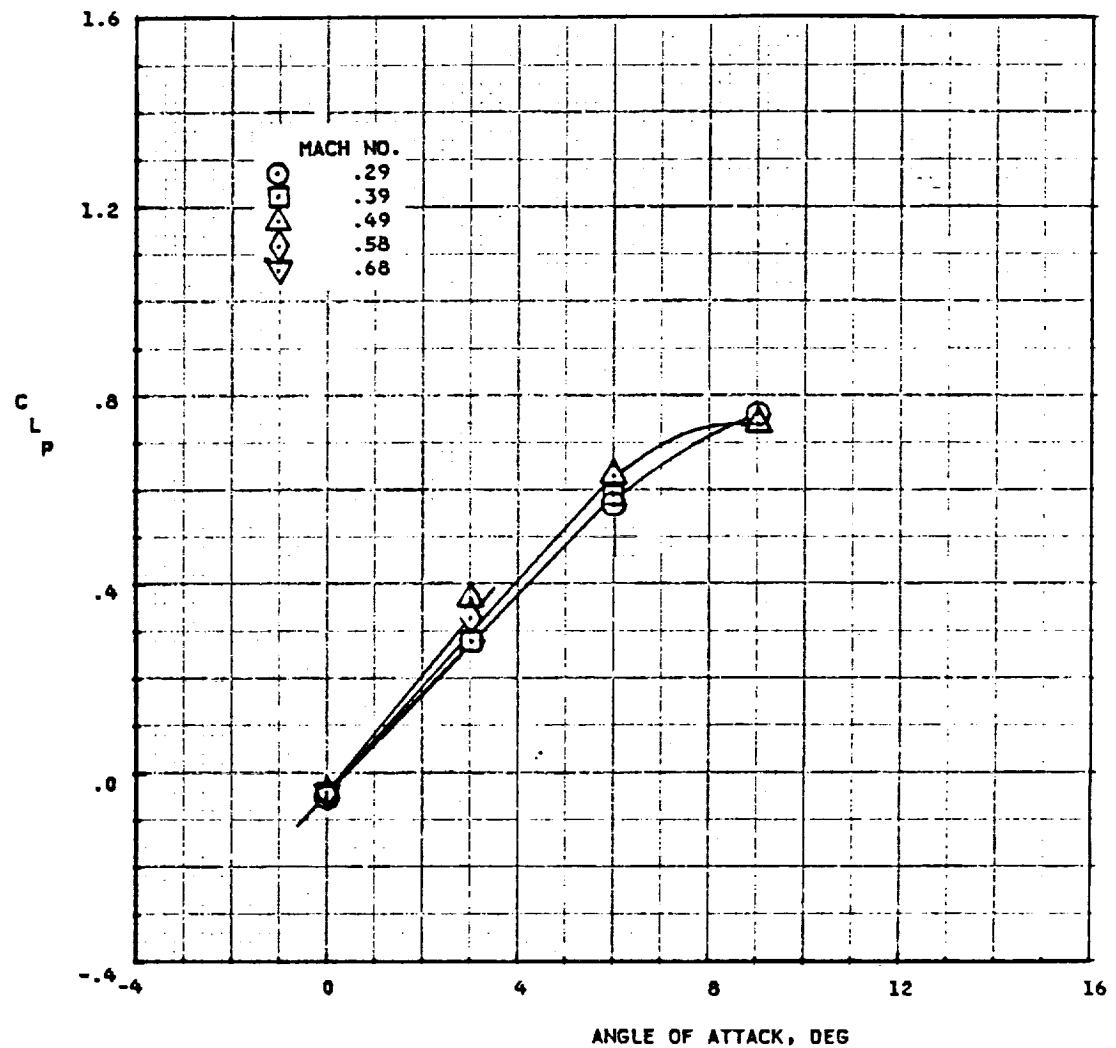
Figure D-10. - (Continued)

ORIGINAL PAGE IS
OF POOR QUALITY



c. Pitching moment coefficient versus lift coefficient

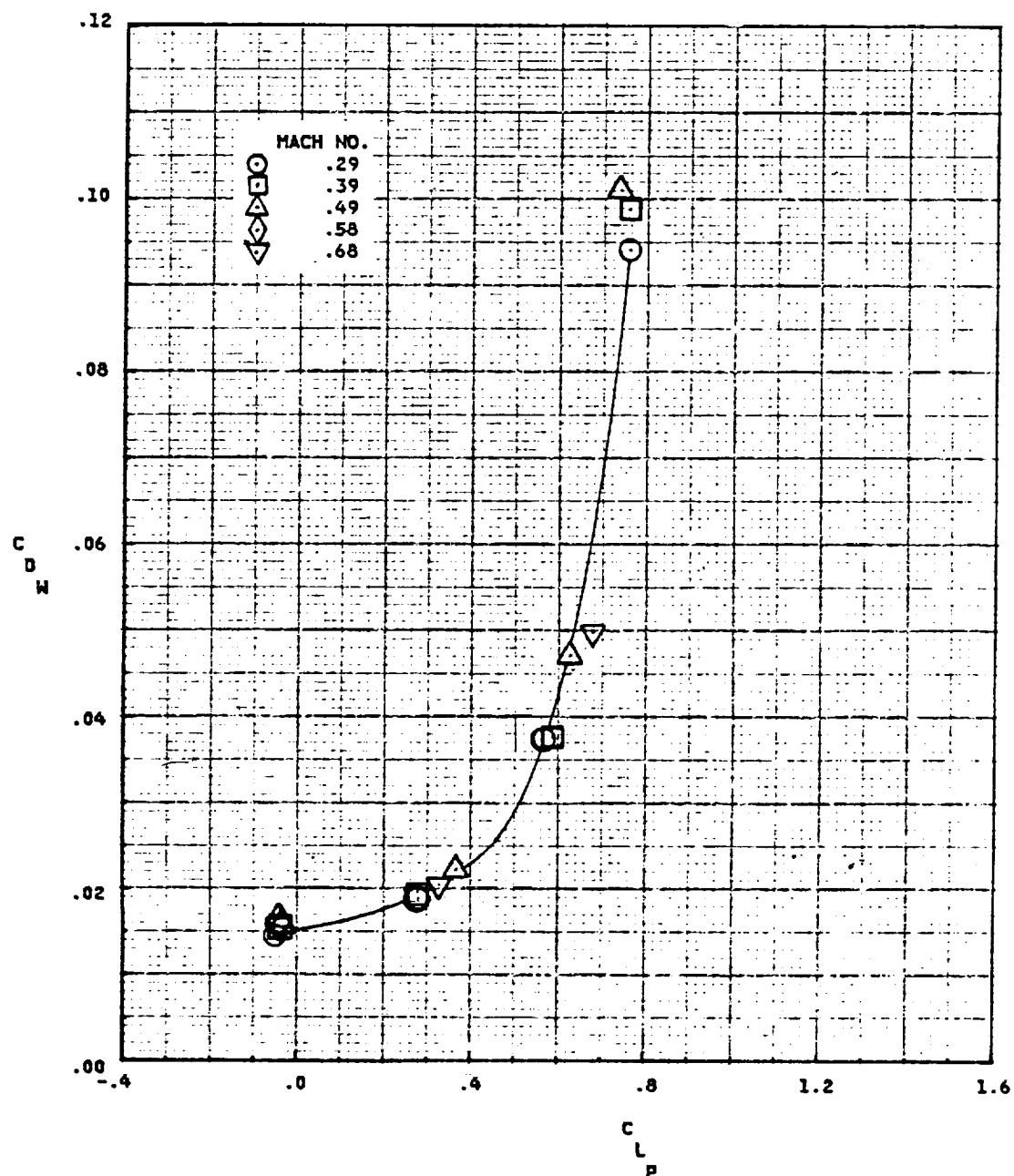
Figure D-10. - (Concluded)



a. Lift coefficient versus angle of attack

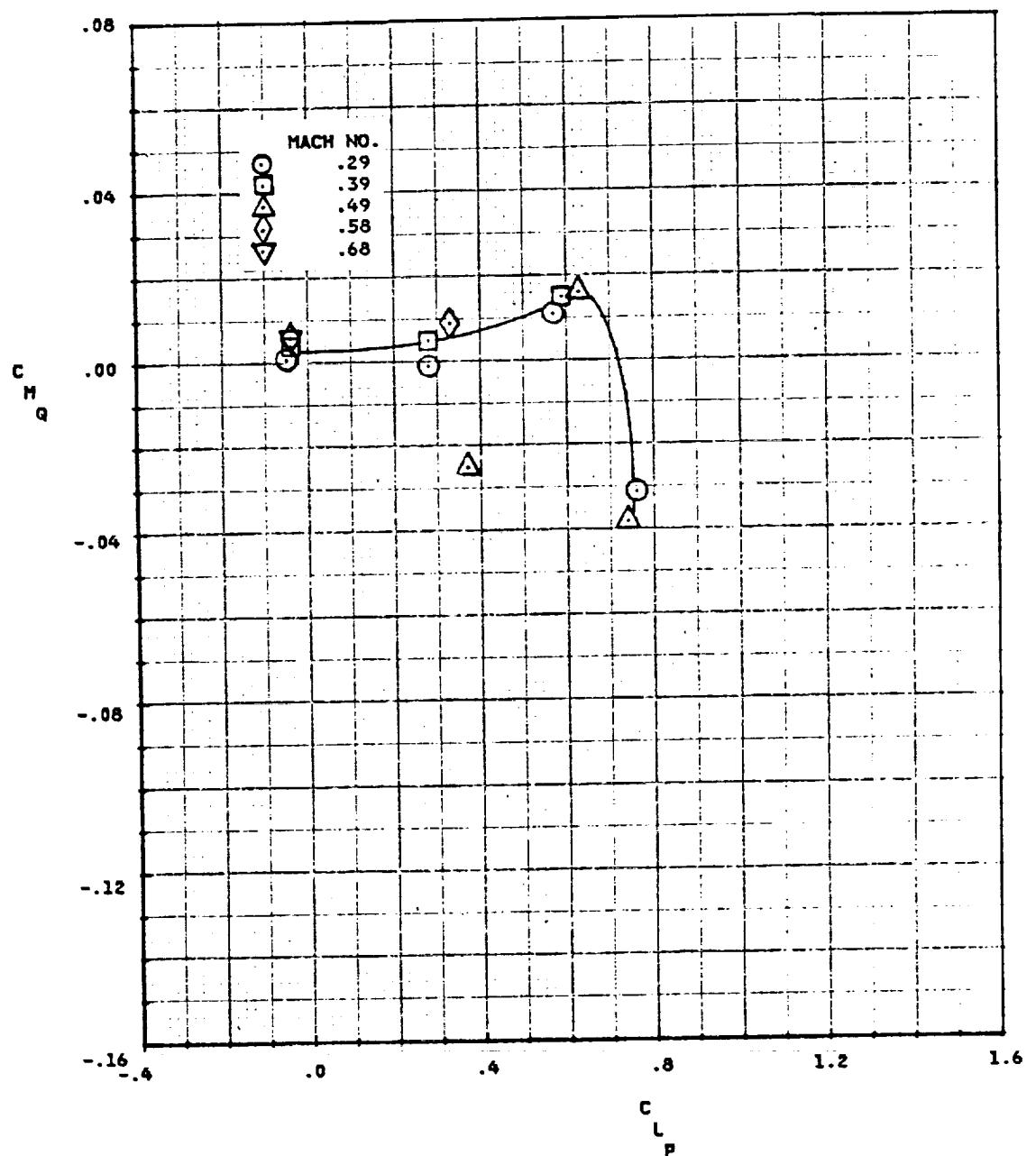
Figure D-11. - Aerodynamic data for the NACA 0012 airfoil with wood simulated ice.

ORIGINAL PAGE IS
OF POOR QUALITY



b. Drag coefficient versus lift coefficient

Figure D-11. - (Continued)



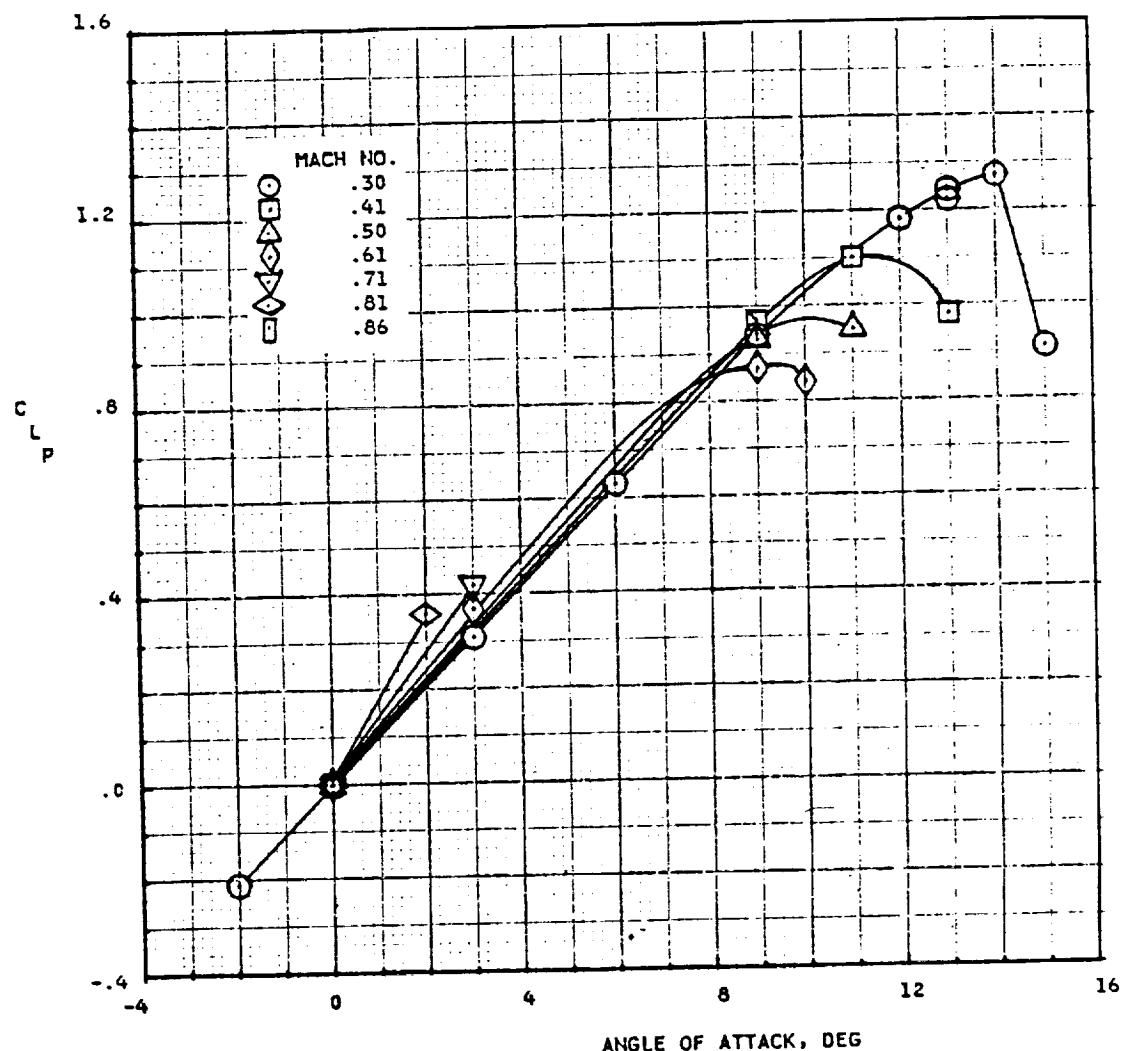
c. Pitching moment coefficient versus lift coefficient

Figure D-11. - (Concluded)

APPENDIX E

OSU 6 x 22 Clean Airfoil and Simulated Ice Test Data

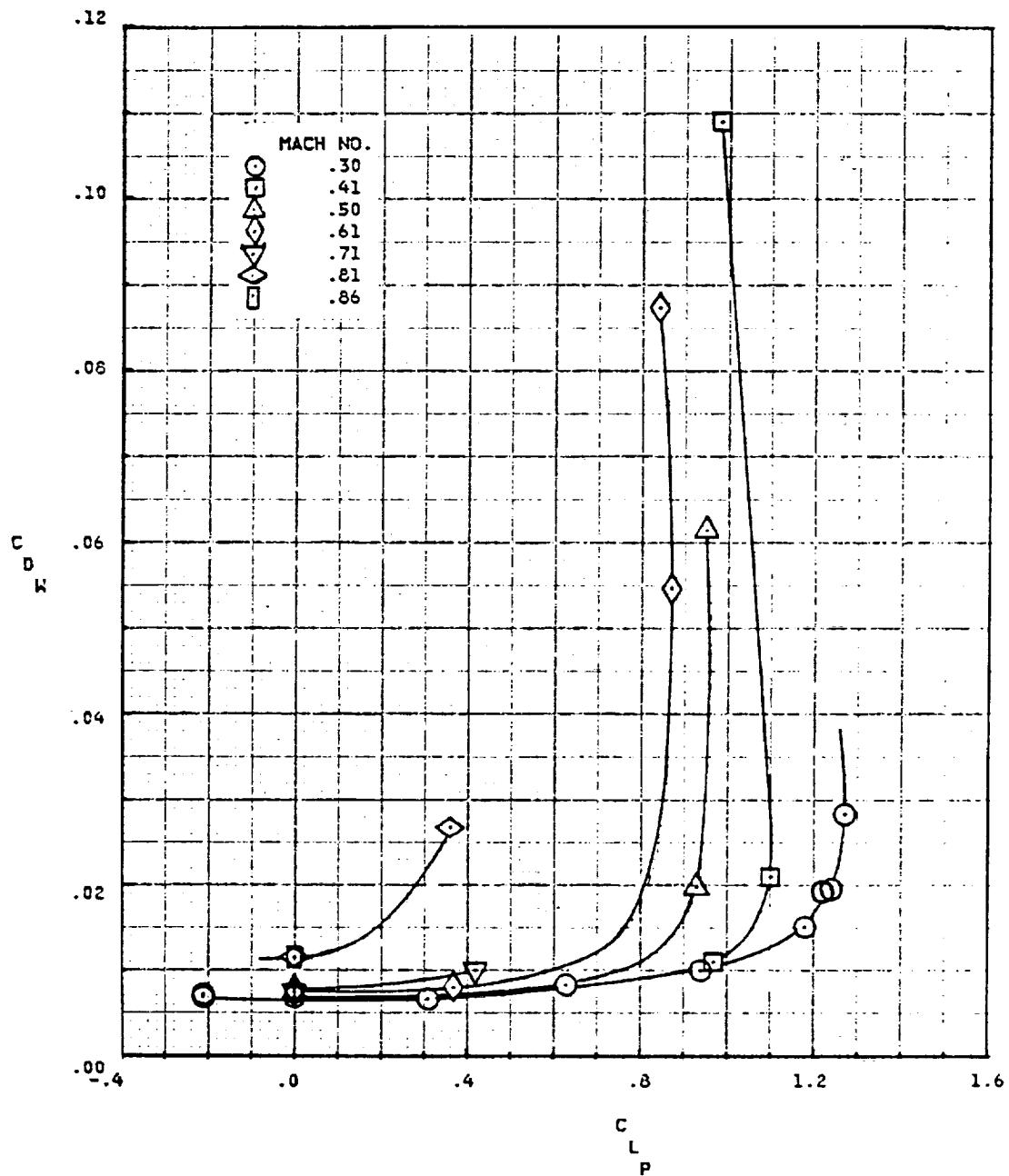
Figures E-1 through E-16 present the lift, drag and pitching moment coefficient data acquired in the Ohio State University 6 x 22 Transonic Airfoil Facility, for both clean airfoils and airfoils with simulated ice bonded to the leading edge. The data fairings have been used to produce aerodynamic increments for the simulated ice models.



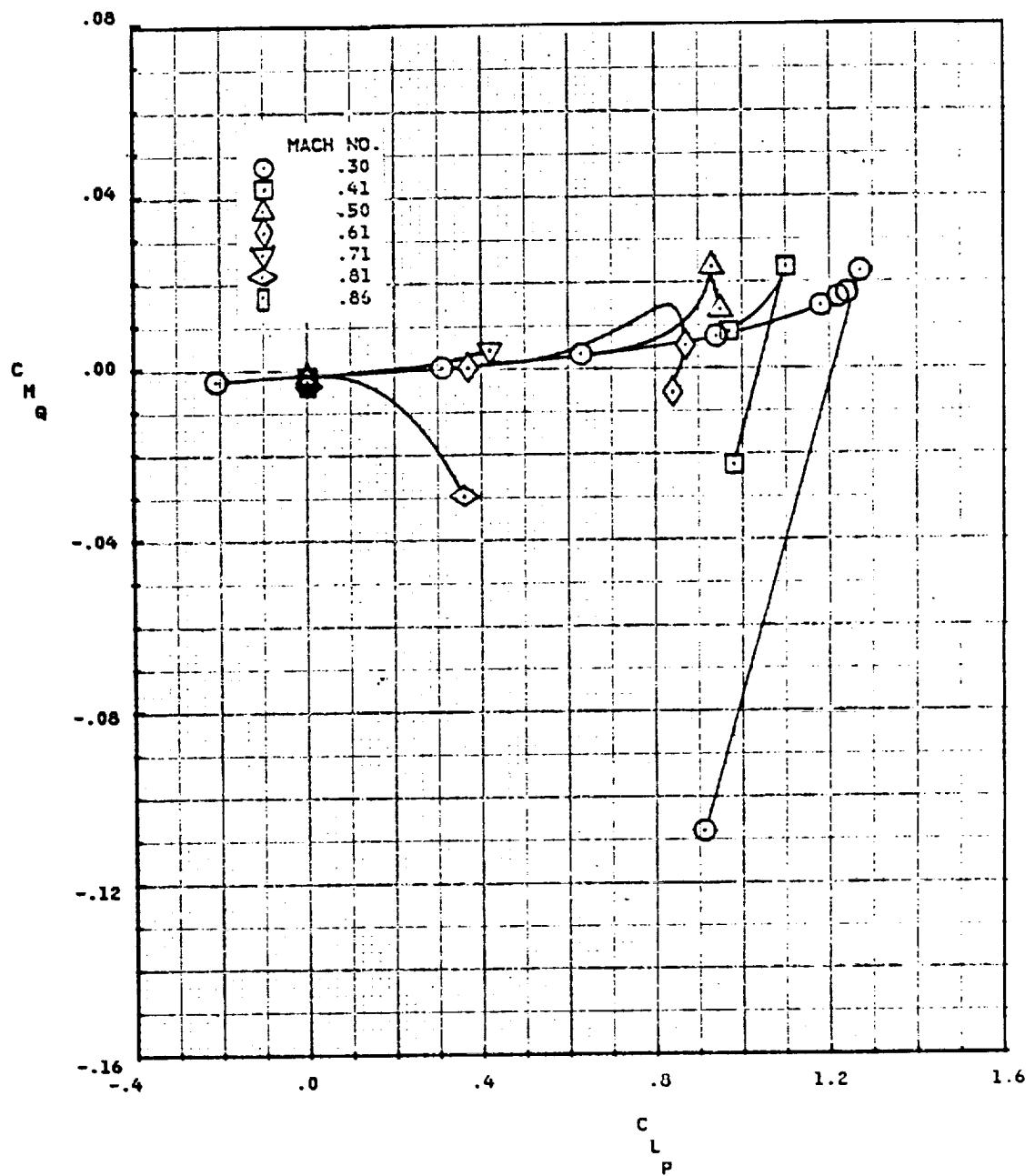
a. Lift coefficient versus angle of attack

Figure E-1. - Aerodynamic data for the clean NACA 0012 airfoil.

ORIGINAL PAGE IS
OF POOR QUALITY

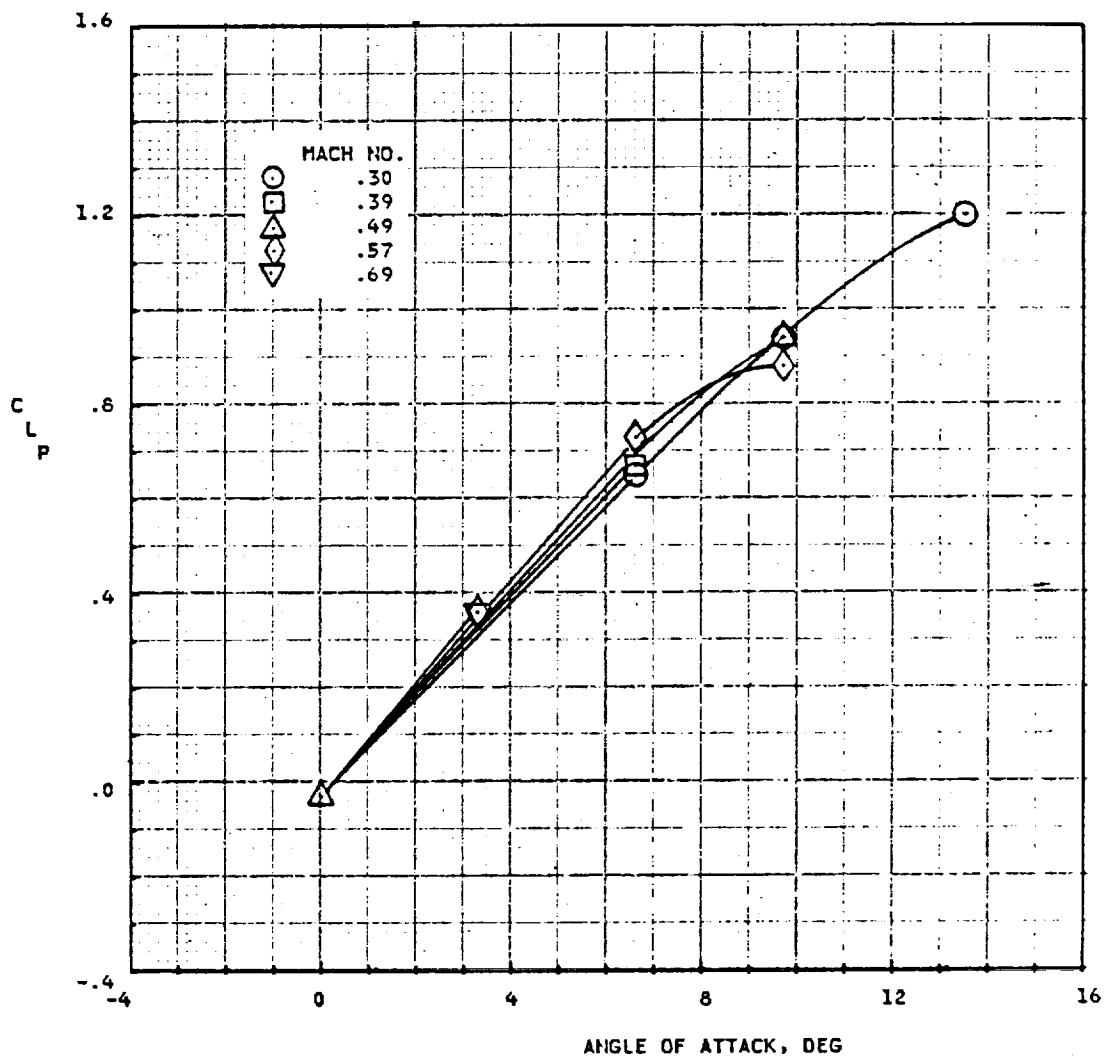


b. Drag coefficient versus lift coefficient
Figure E-1. (Continued)



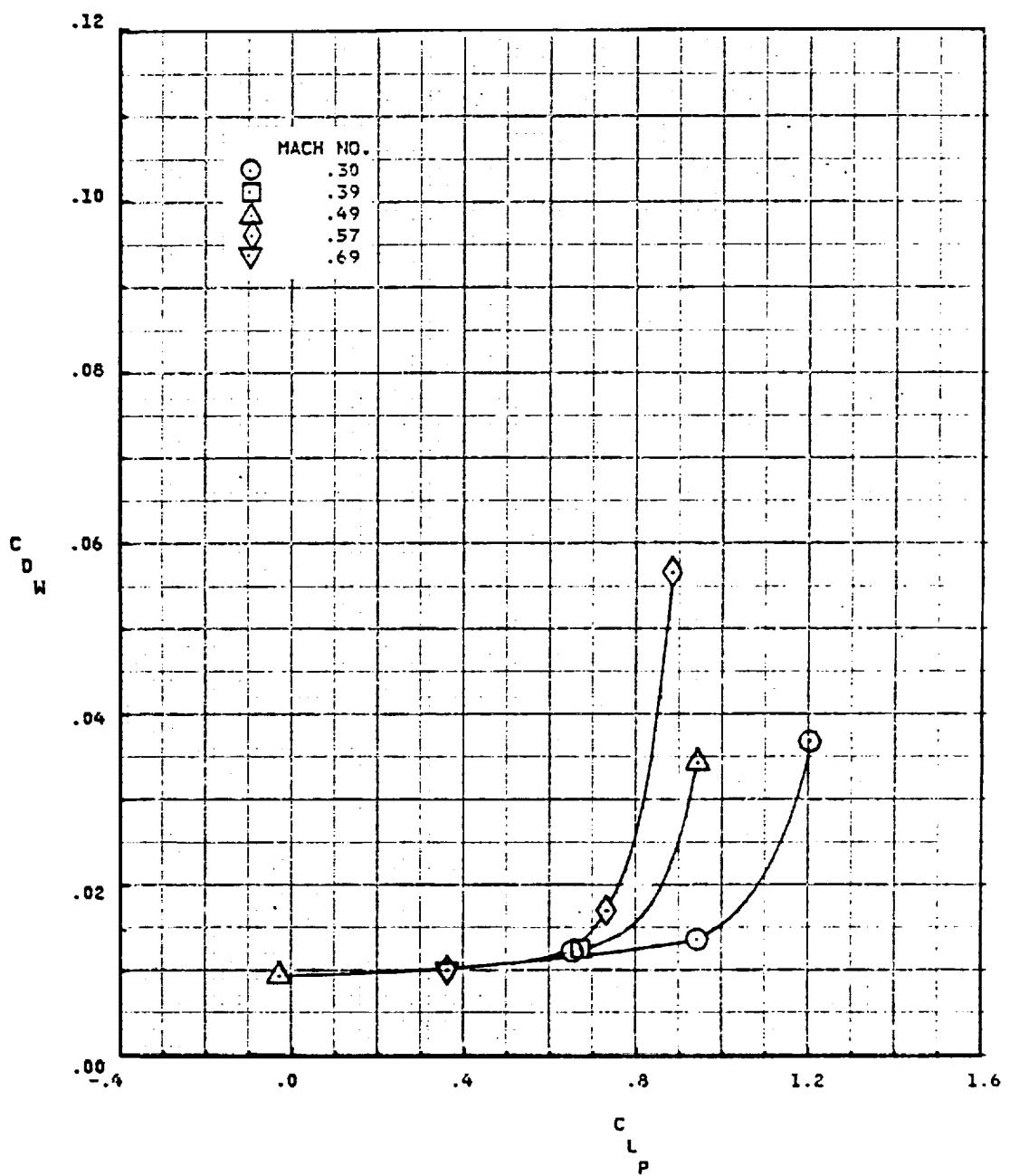
c. Pitching moment coefficient versus lift coefficient
 Figure E-1. (Concluded)

ORIGINAL PAGE IS
OF POOR QUALITY



a. Lift coefficient versus angle of attack

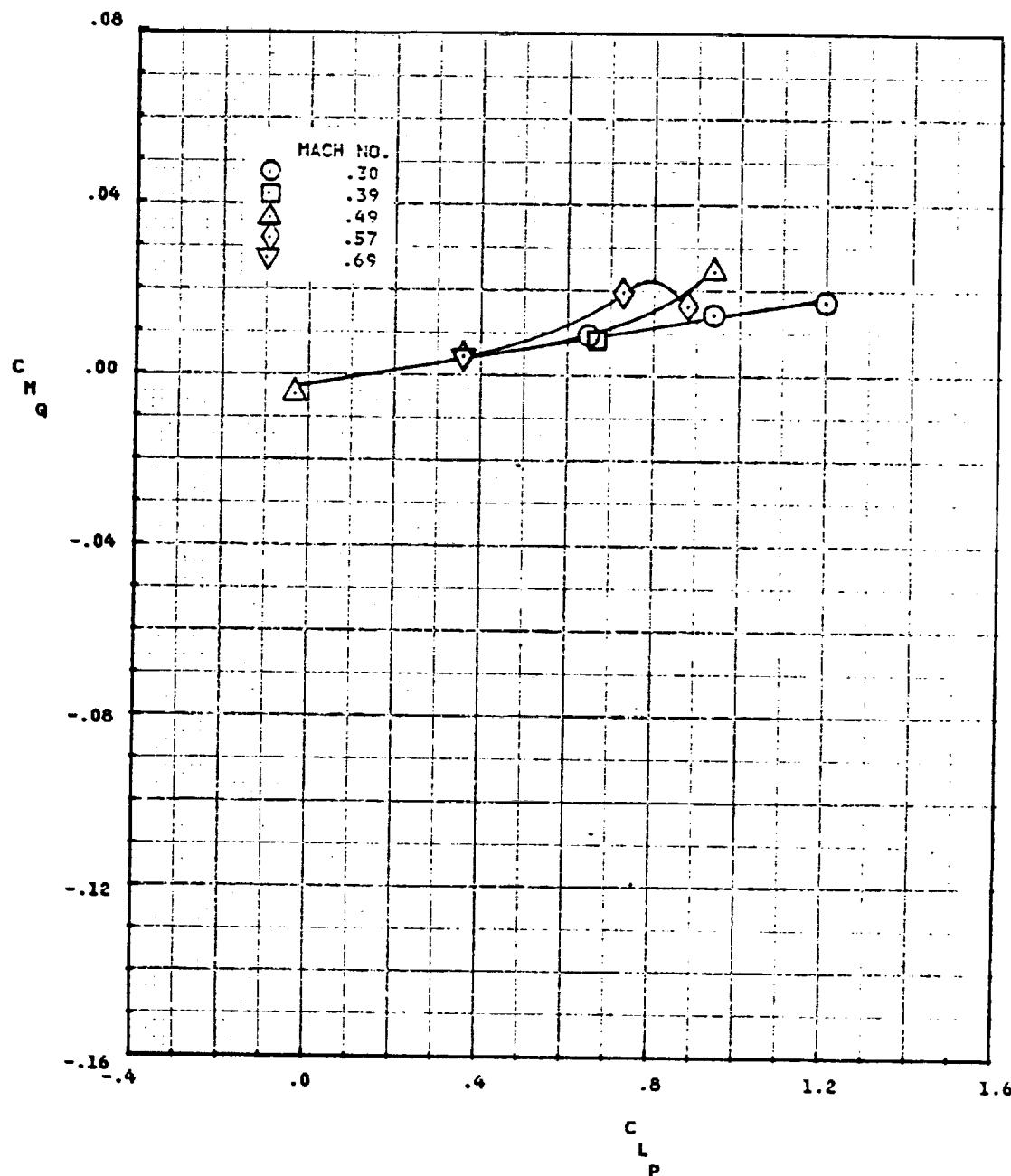
Figure E-2. - Aerodynamic data for the NACA 0012 airfoil with simulated ice number 1.



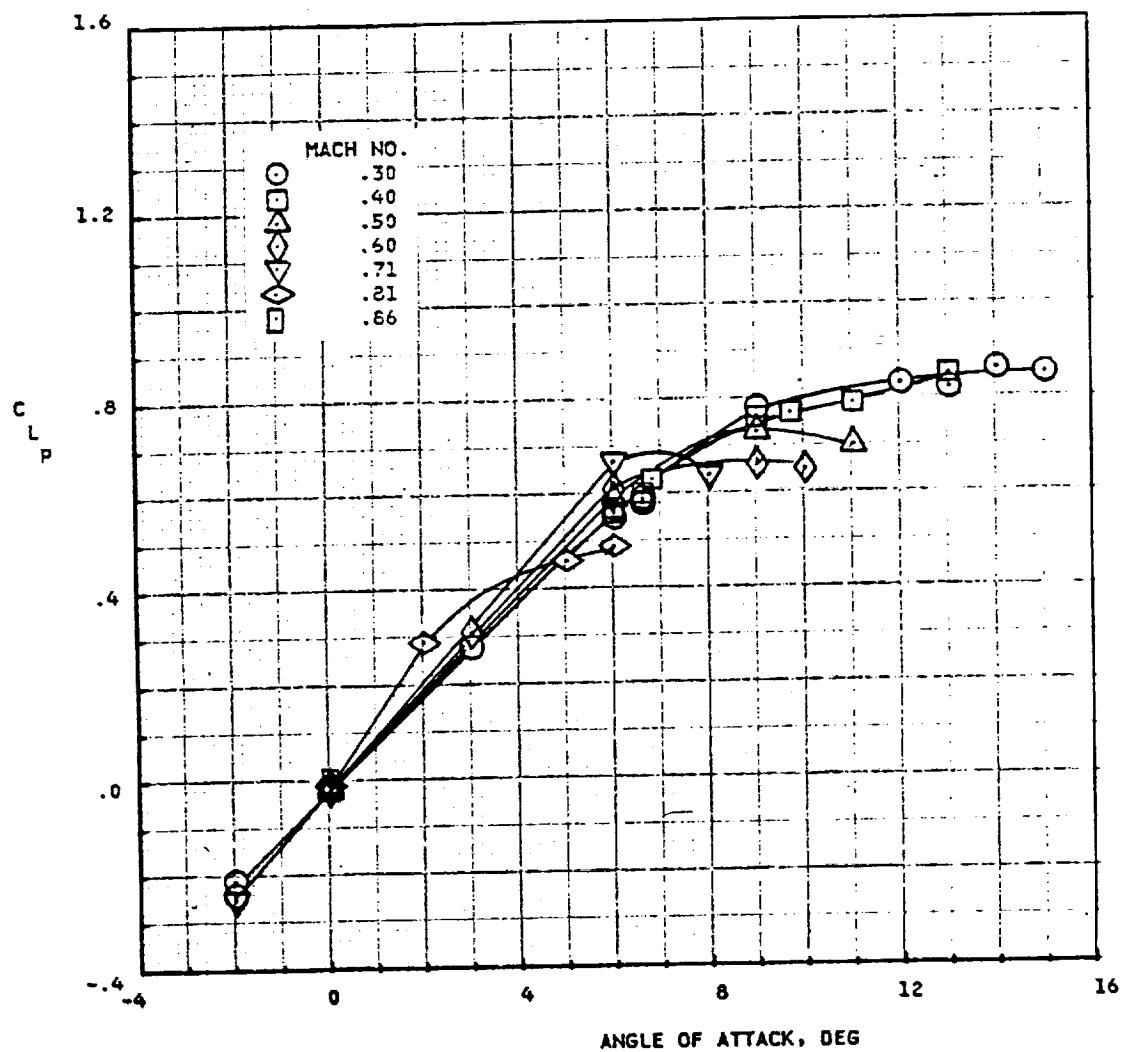
b. Drag coefficient versus lift coefficient

Figure E-2. (Continued)

ORIGINAL PAGE IS
OF POOR QUALITY



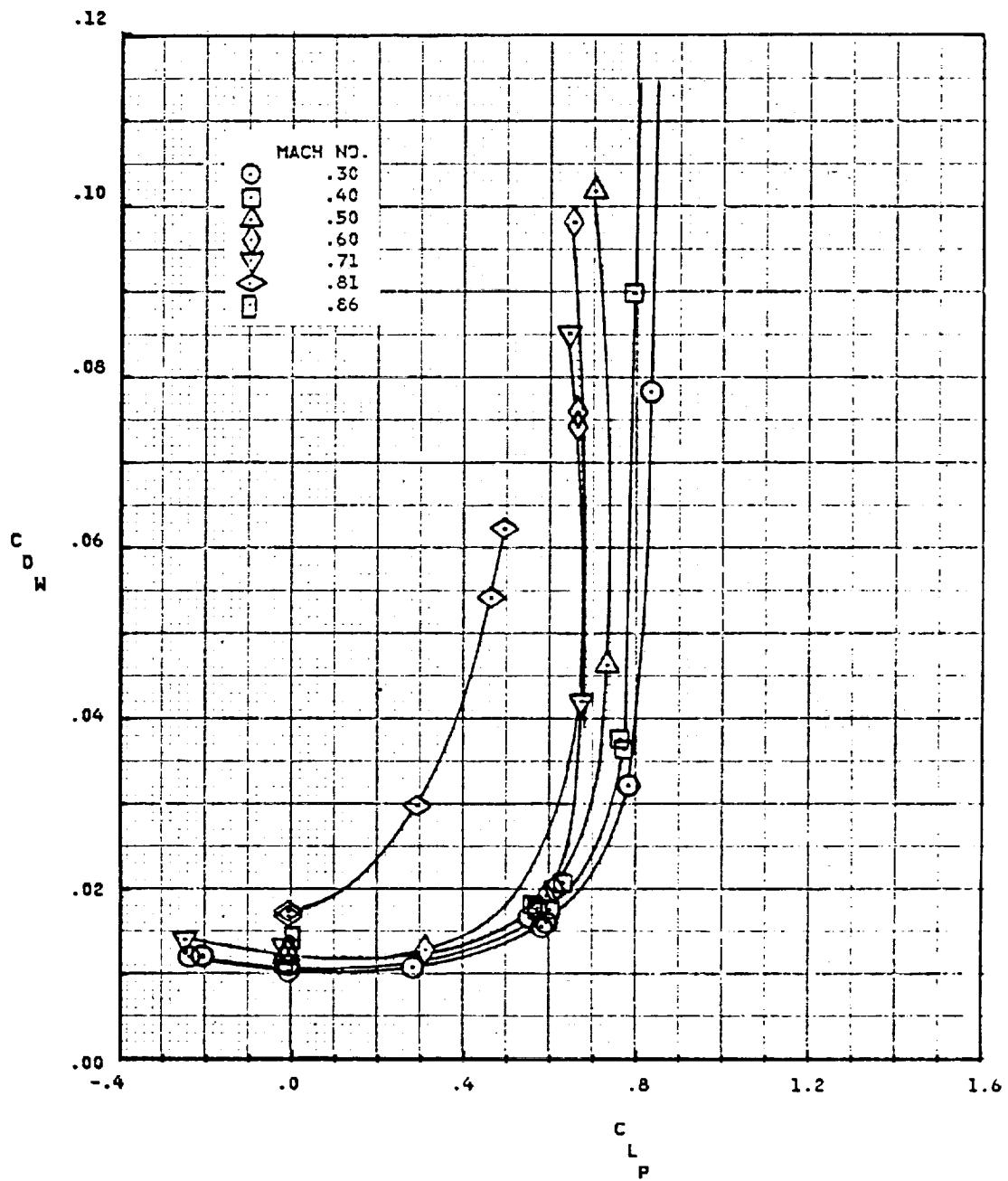
c. Pitching moment coefficient versus lift coefficient
Figure E-2. (Concluded)



a. Lift coefficient versus angle of attack

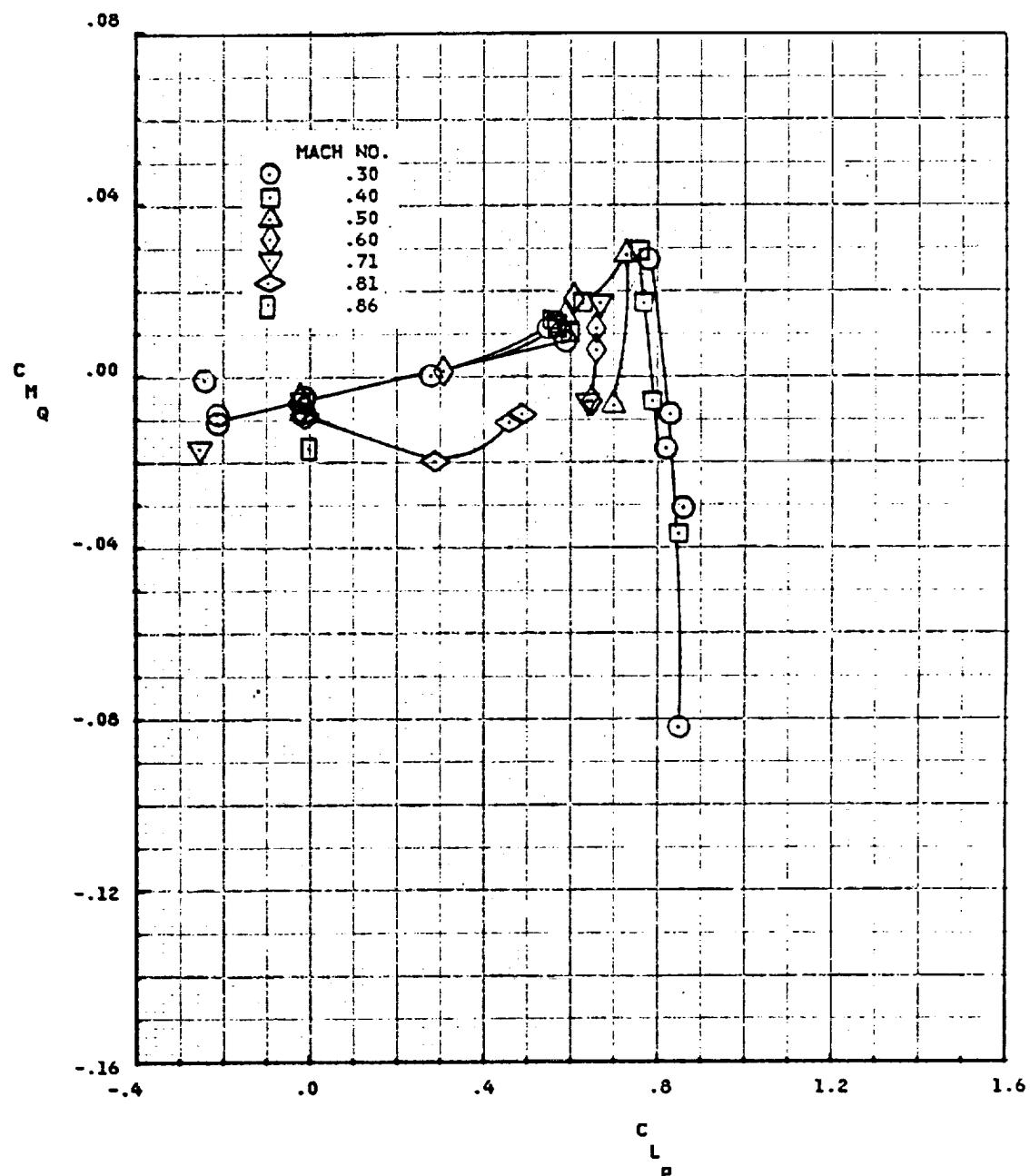
Figure E-3. - Aerodynamic data for the NACA 0012 airfoil with simulated ice number 2.

ORIGINAL PAGE IS
OF POOR QUALITY



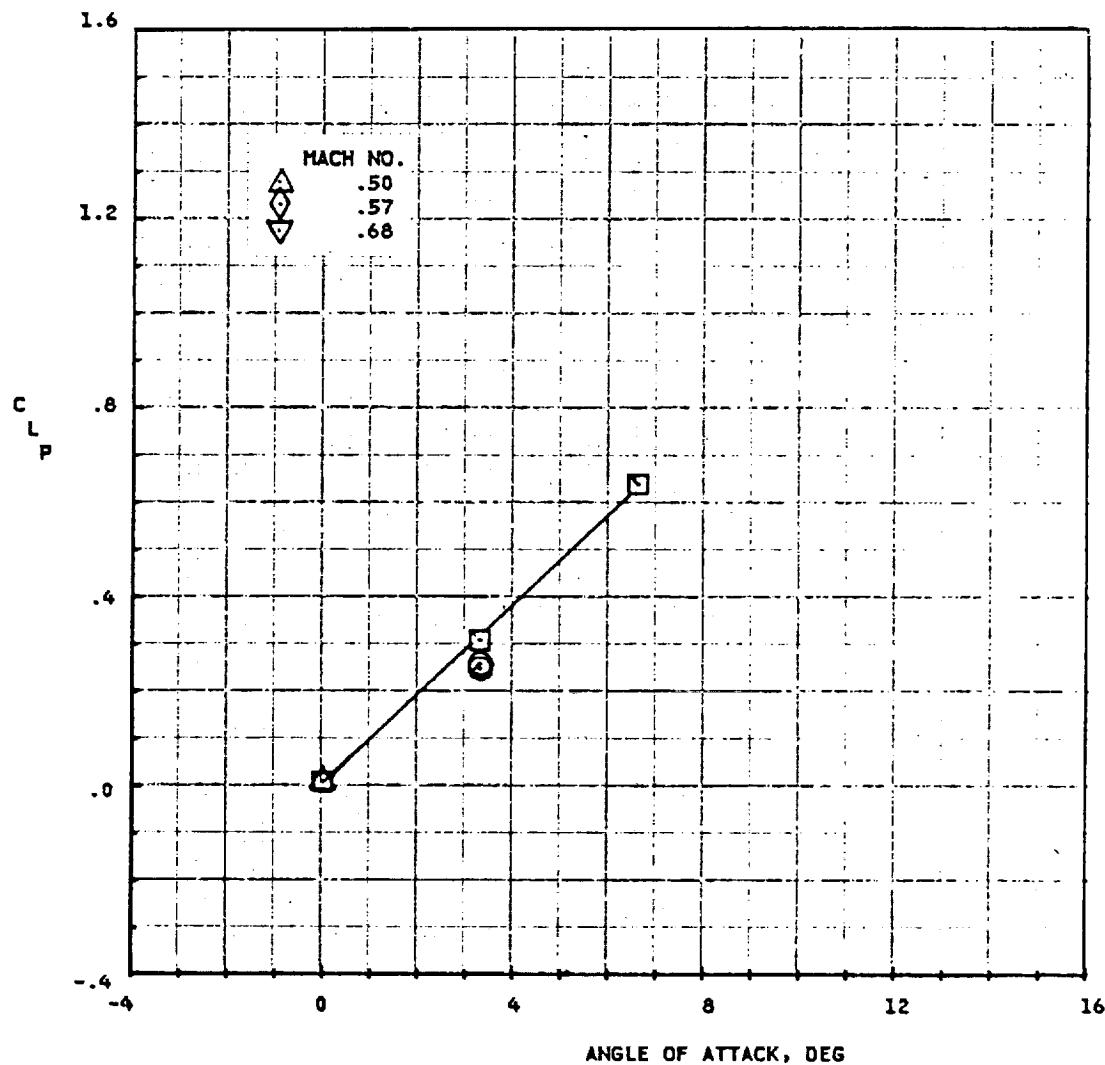
b. Drag coefficient versus lift coefficient

Figure E-3. (Continued)



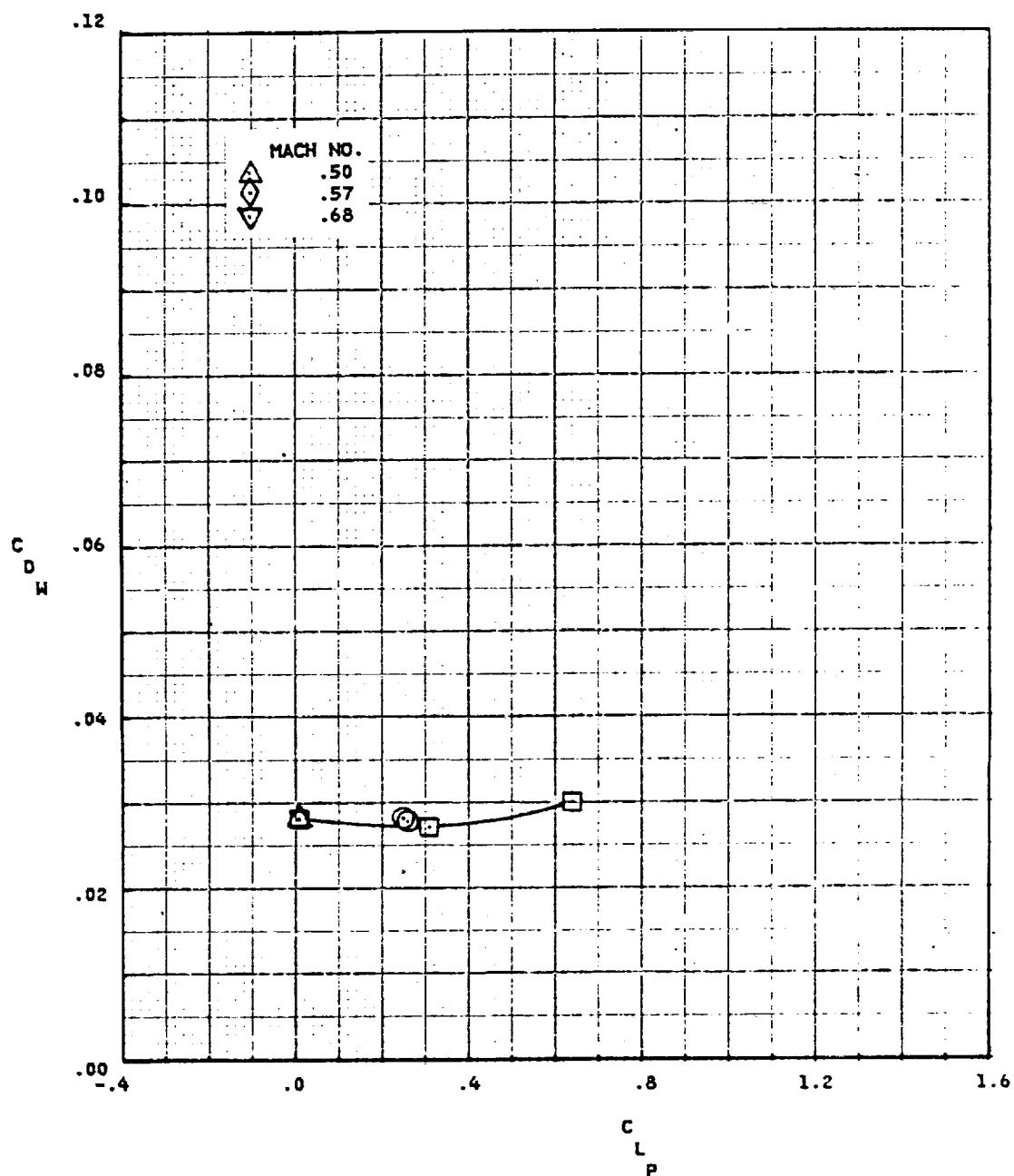
c. Pitching moment coefficient versus lift coefficient
 Figure E-3. (Concluded)

ORIGINAL PAGE IS
OF POOR QUALITY



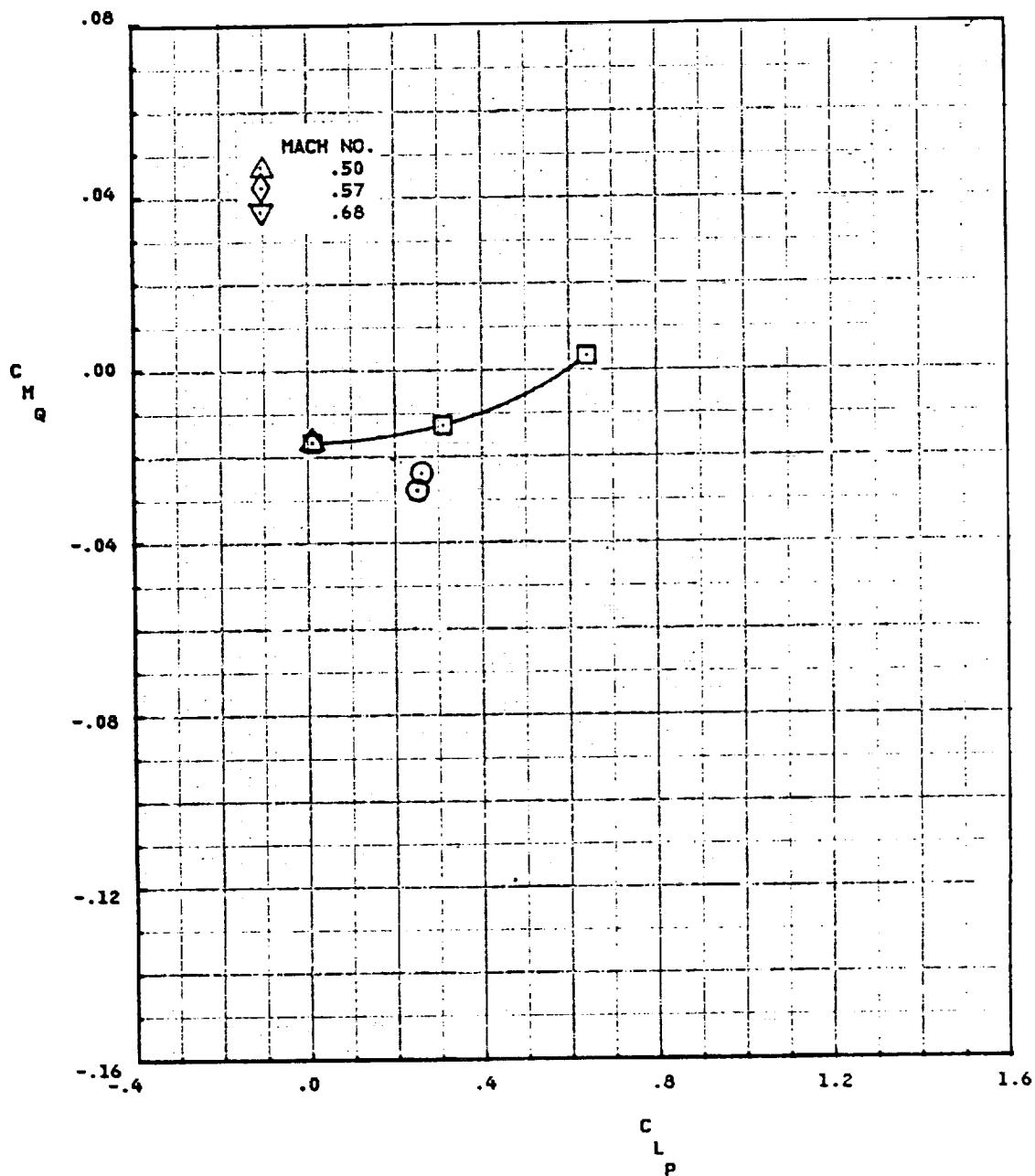
a. Lift coefficient versus angle of attack

Figure E-4. - Aerodynamic data for the NACA 0012 airfoil with simulated ice number 3.



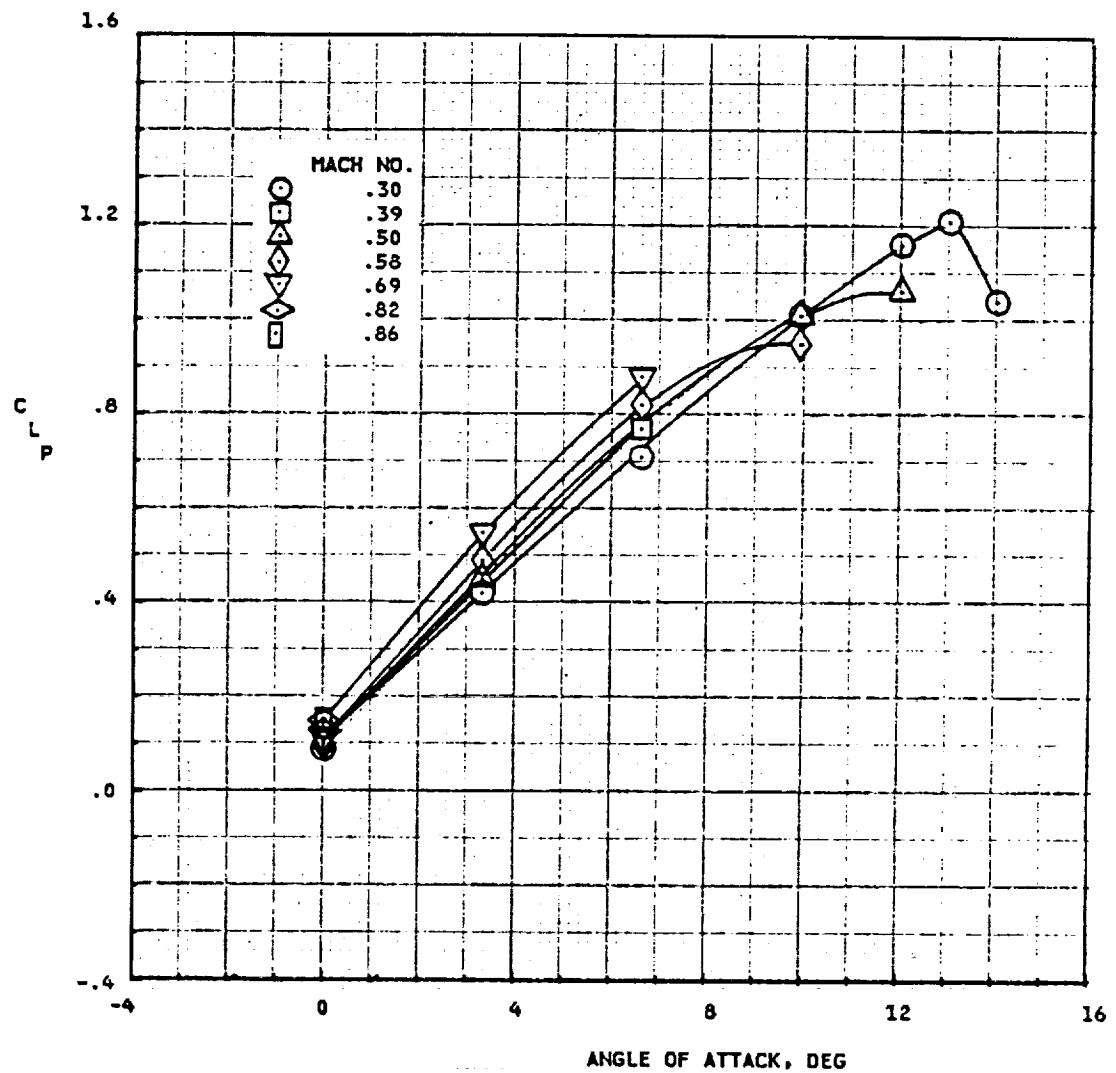
b. Drag coefficient versus lift coefficient
Figure E-4. (Continued)

ORIGINAL PAGE 15
OF POOR QUALITY



c. Pitching moment coefficient versus lift coefficient

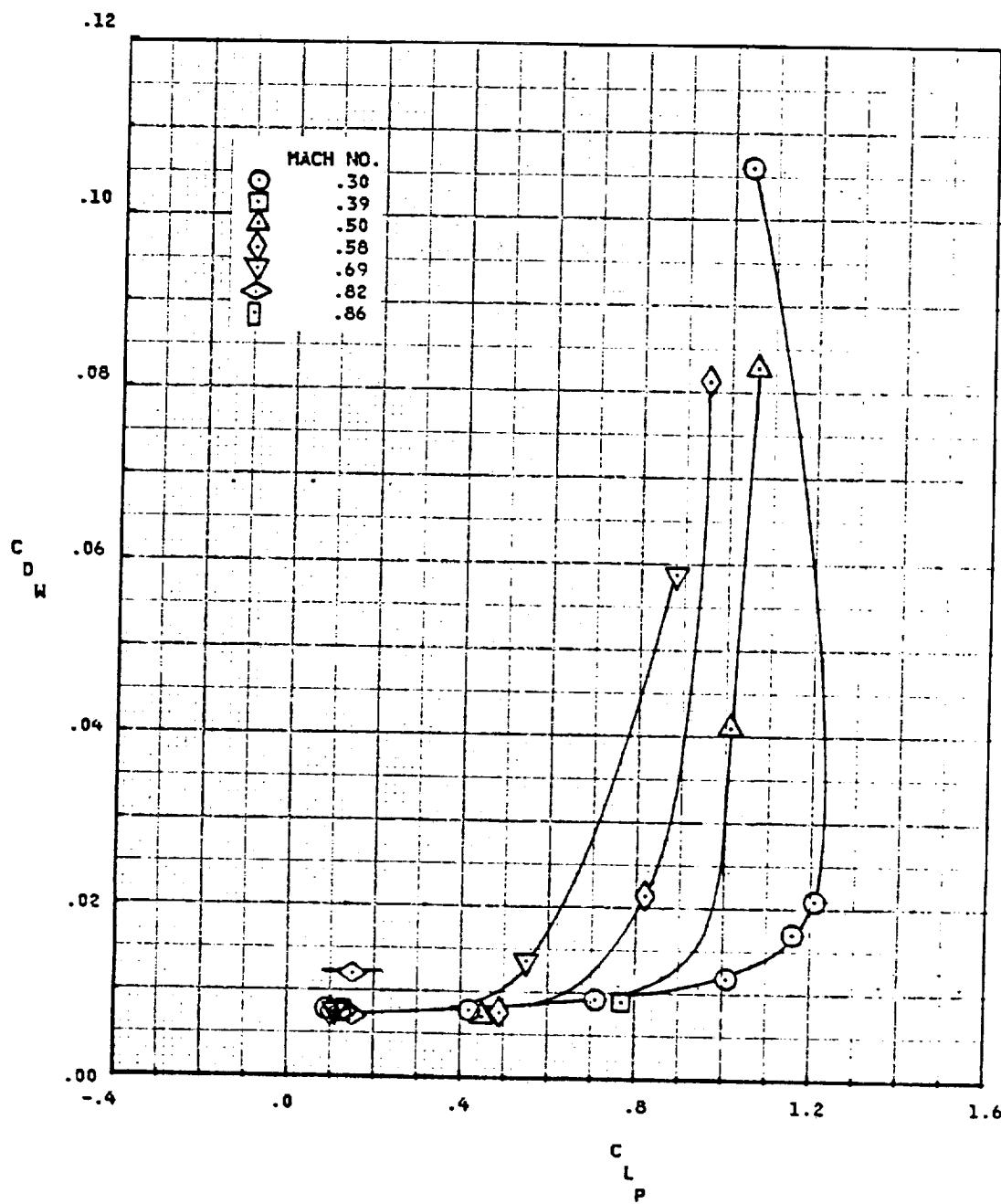
Figure E-4. (Concluded)

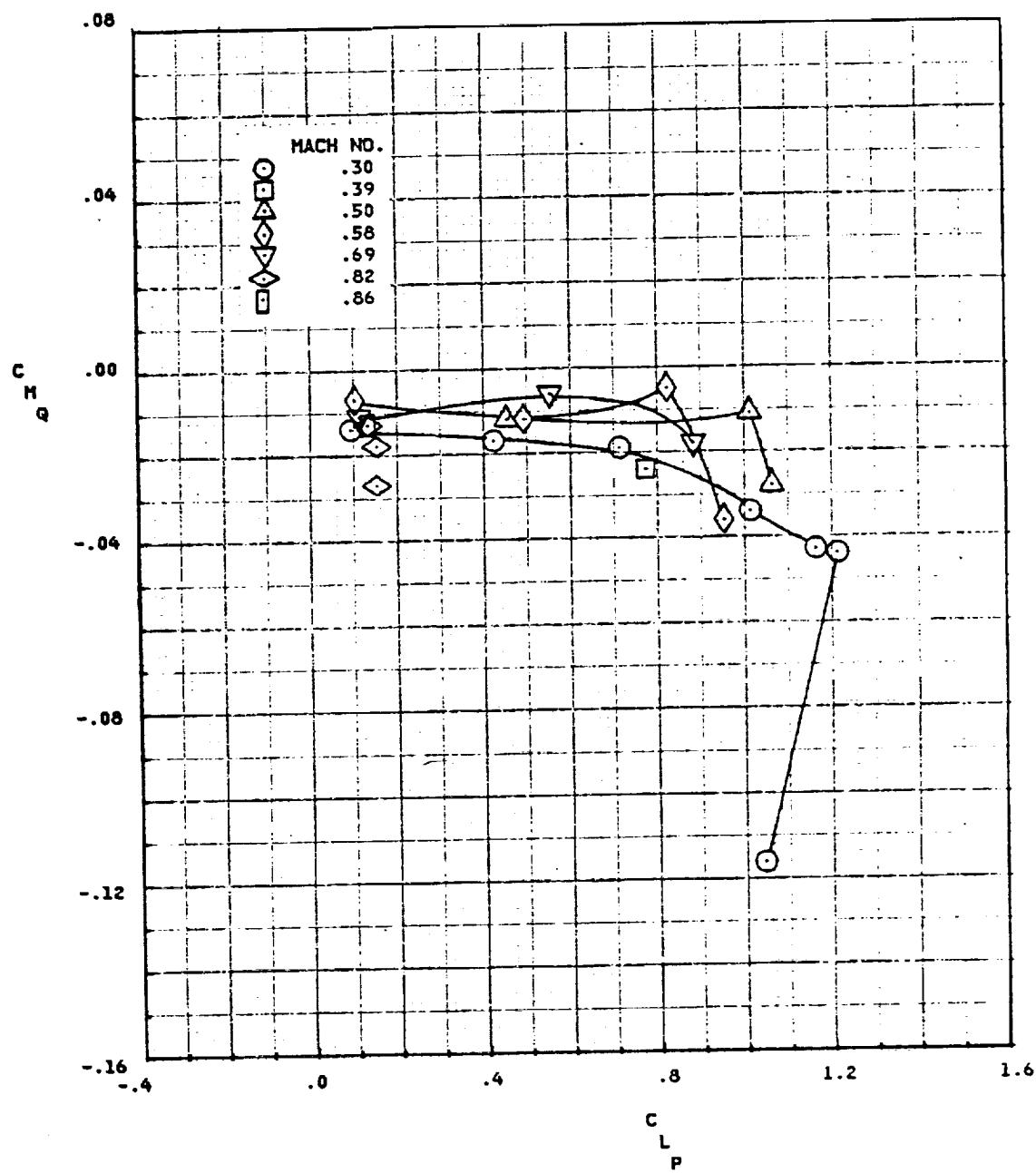


a. Lift coefficient versus angle of attack

Figure E-5. - Aerodynamic data for the clean SC1095 airfoil.

ORIGINAL PAGE IS
OF POOR QUALITY

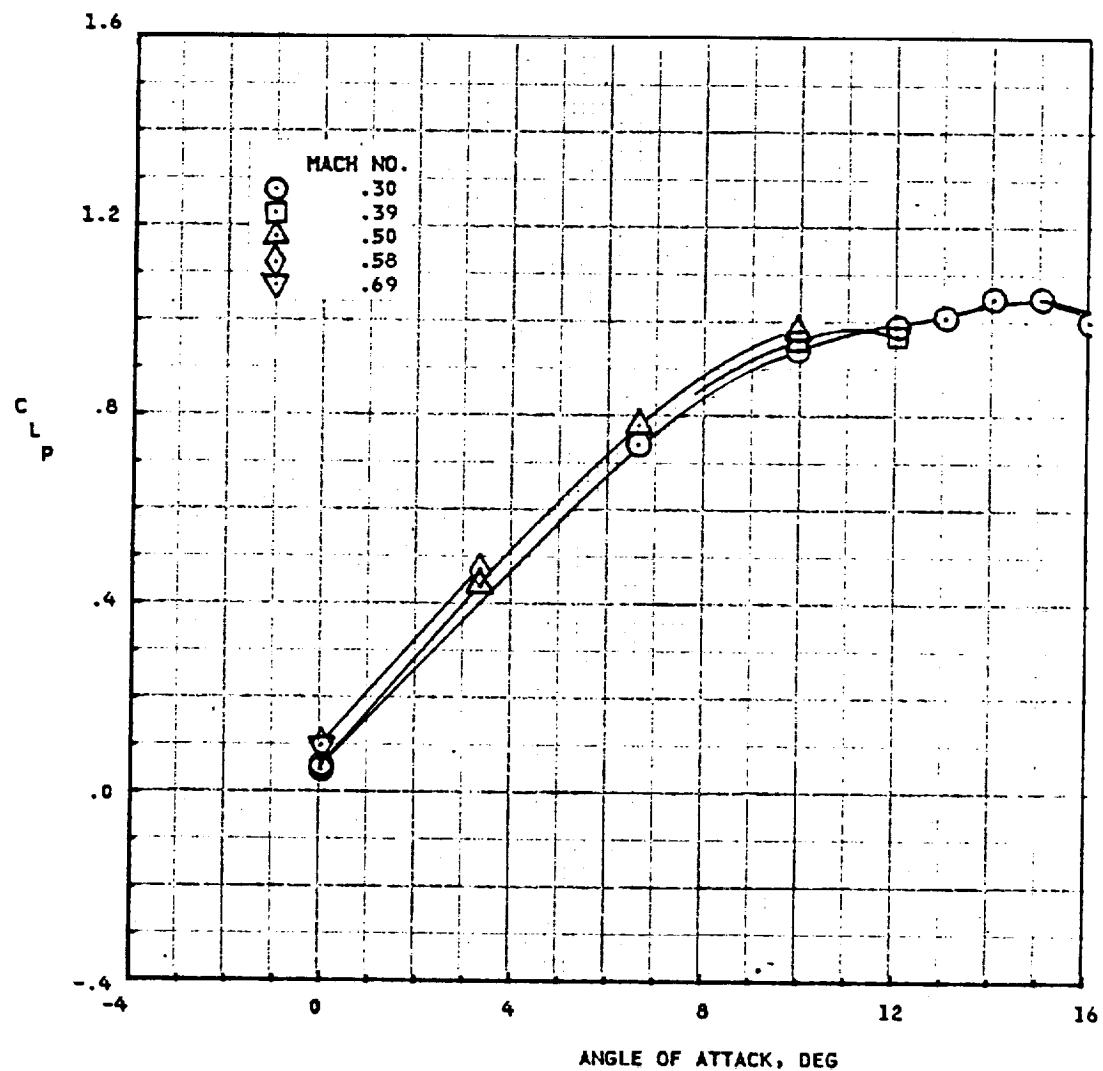




c. Pitching moment coefficient versus lift coefficient

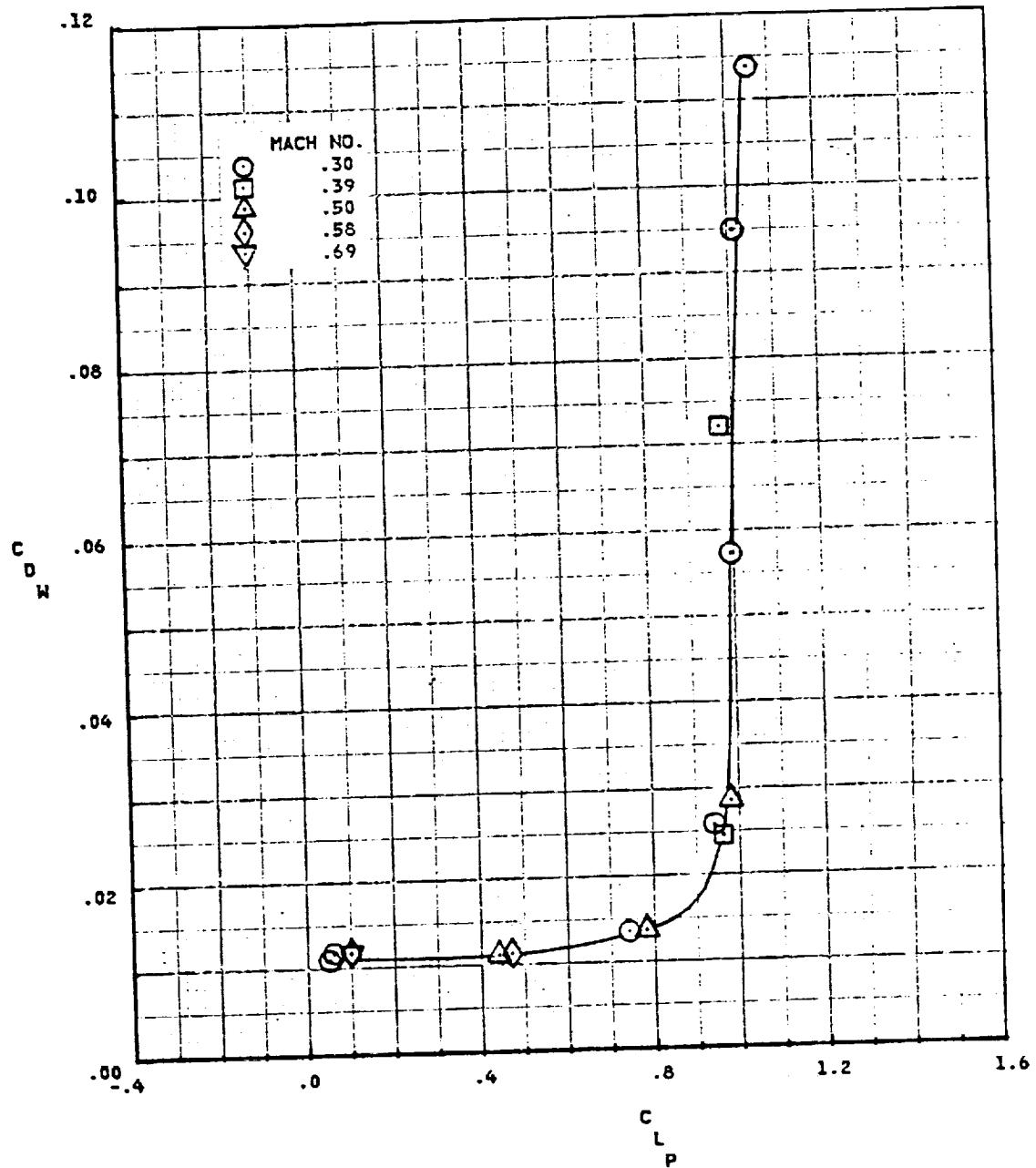
Figure E-5. (Concluded)

ORIGINAL PAGE IS
OF POOR QUALITY



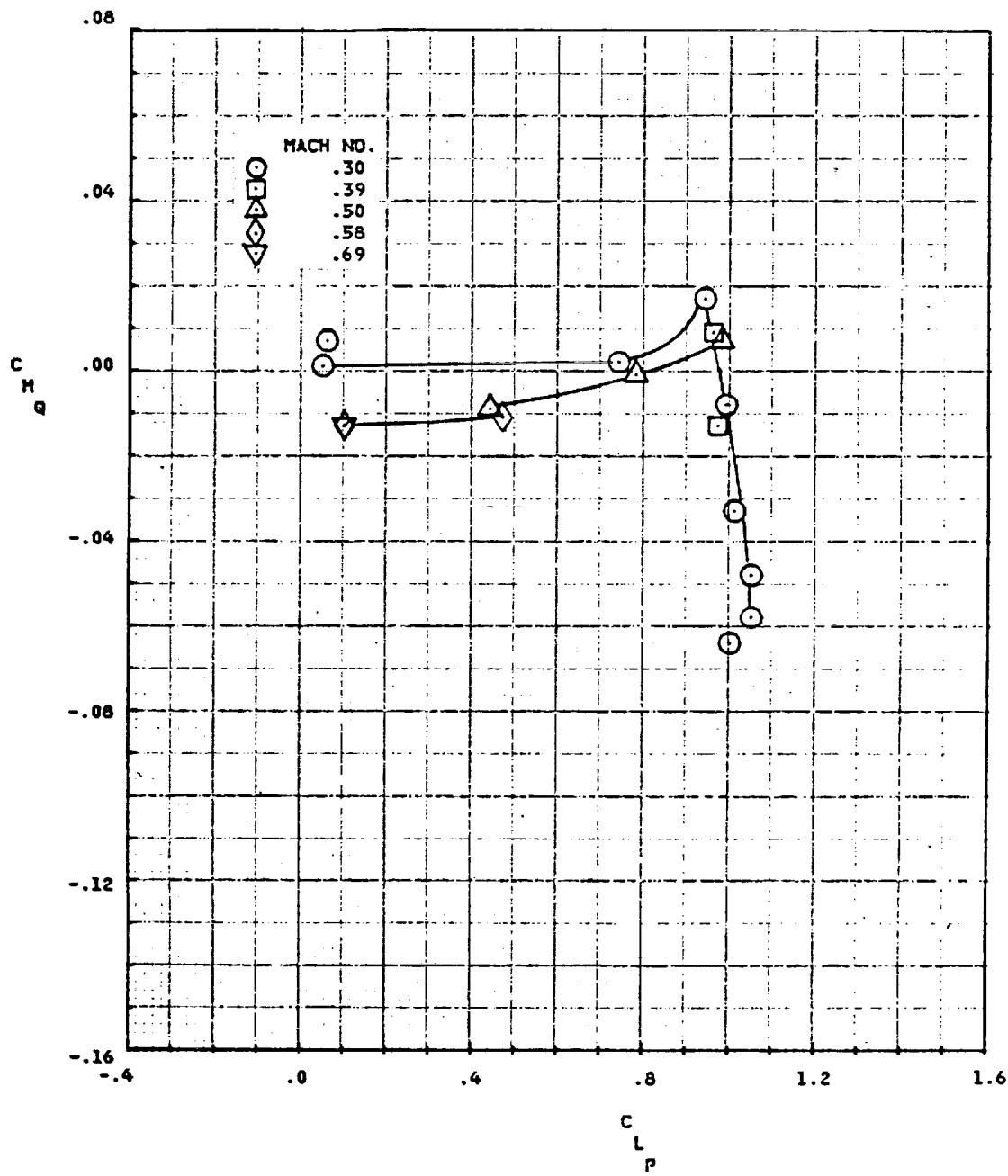
a. Lift coefficient versus angle of attack

Figure E-6. - Aerodynamic data for the SC1095 airfoil with simulated ice number 1.

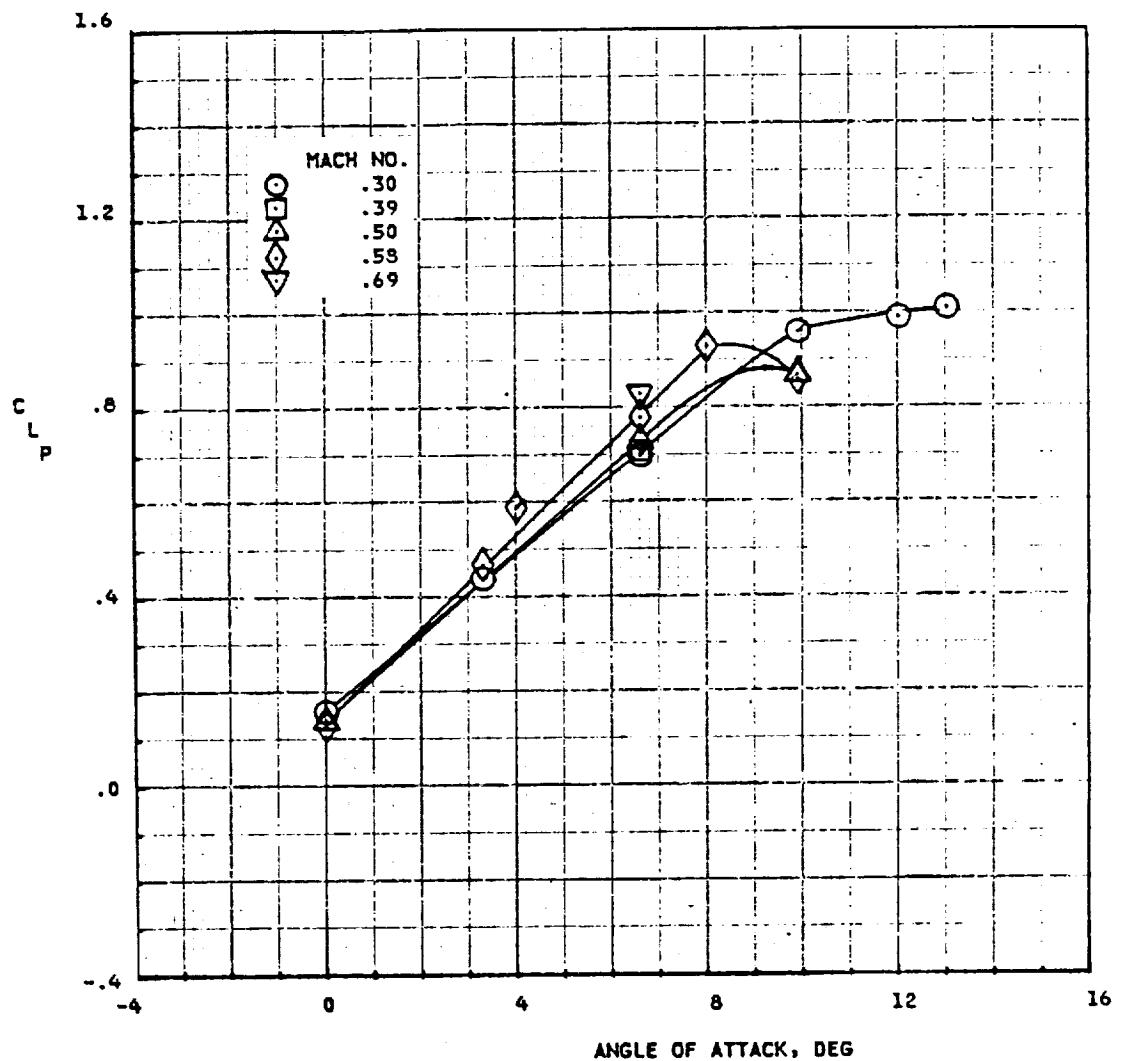


b. Drag coefficient versus lift coefficient
 Figure E-6. (Continued)

ORIGINAL PAGE IS
OF POOR QUALITY



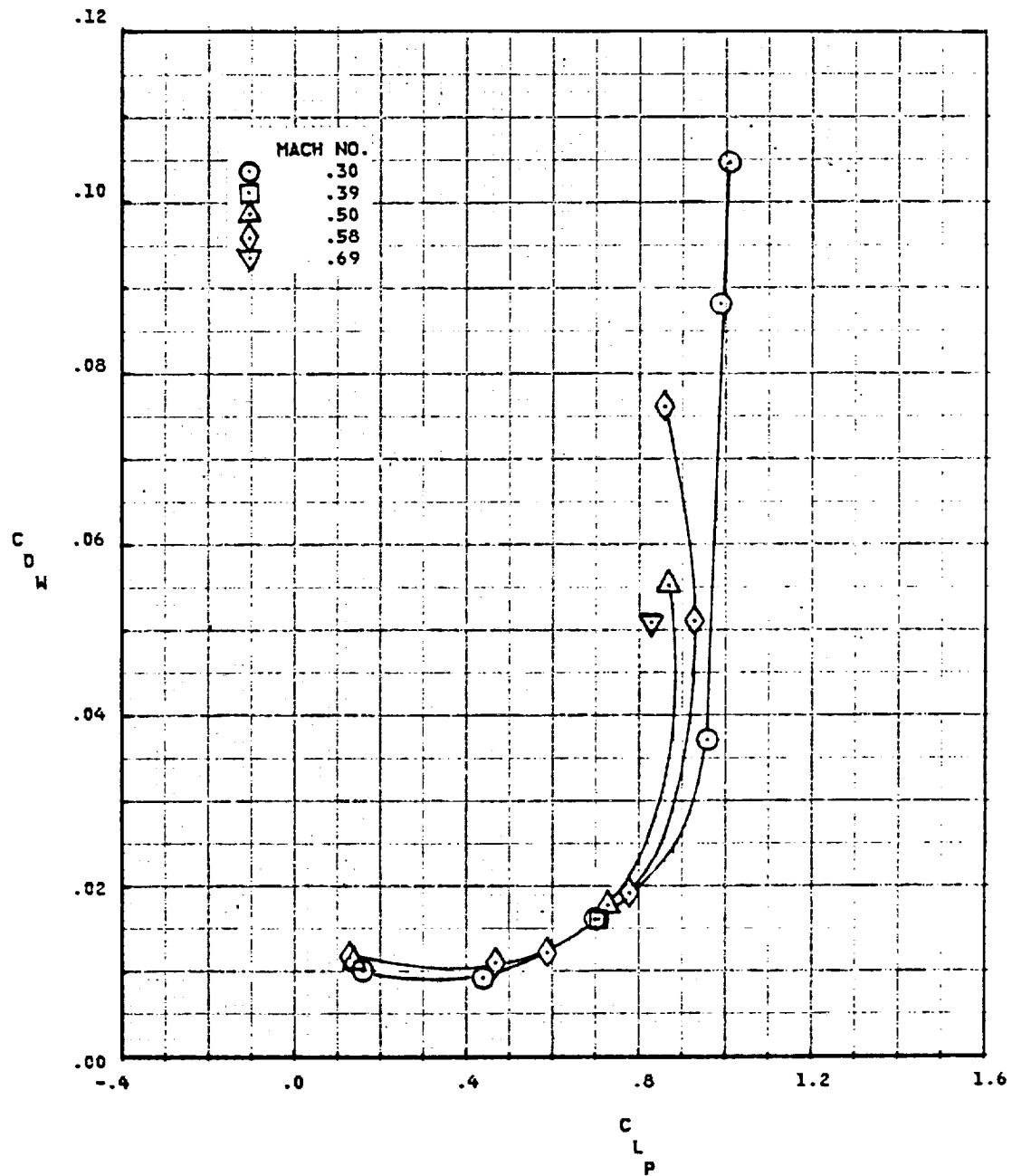
c. Pitching moment coefficient versus lift coefficient
Figure E-6. (Concluded)



a. Lift coefficient versus angle of attack

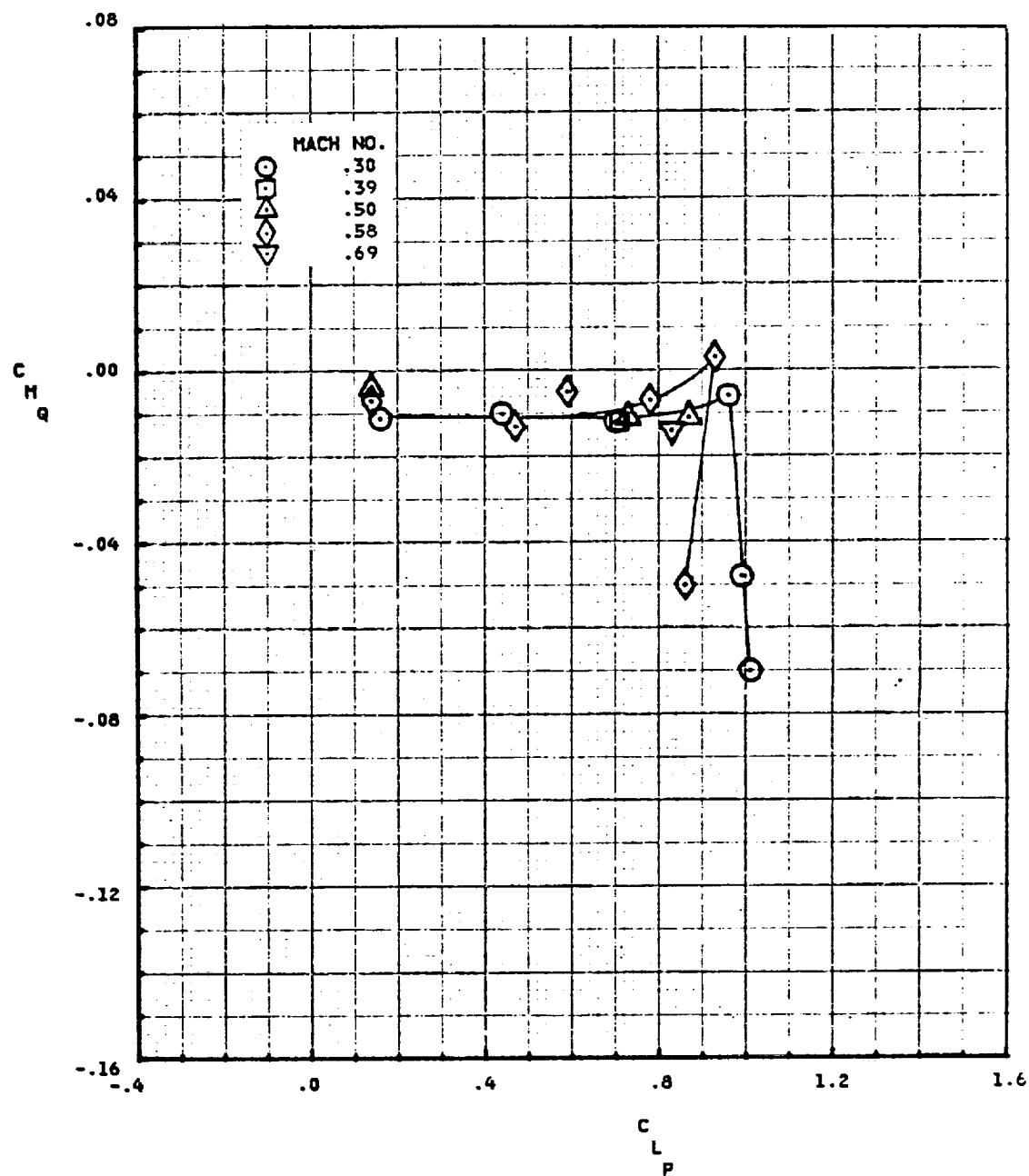
Figure E-7. - Aerodynamic data for the SC1095 airfoil with simulated ice number 2.

ORIGINAL PAGE IS
OF POOR QUALITY



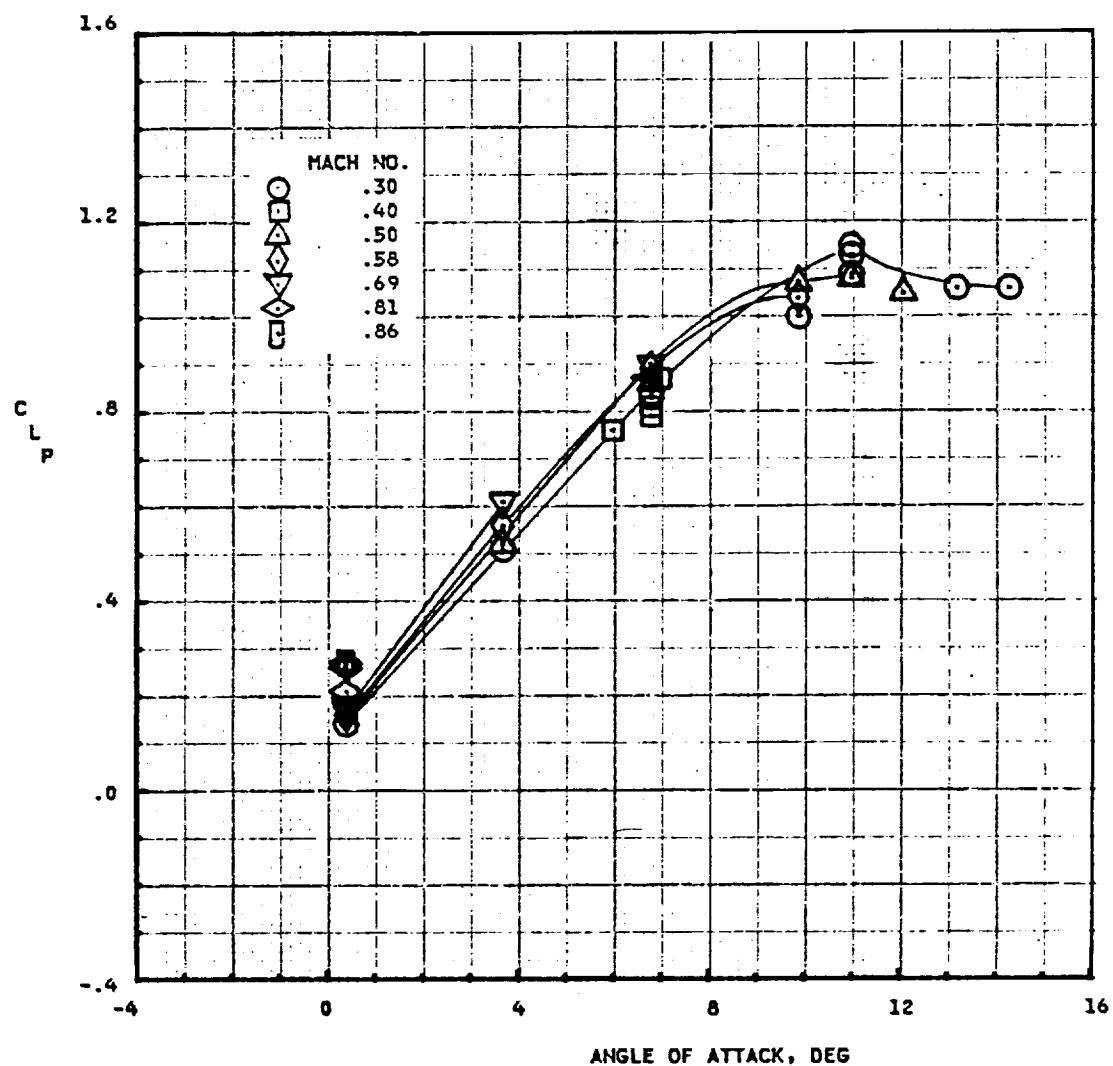
b. Drag coefficient versus lift coefficient

Figure E-7. (Continued)



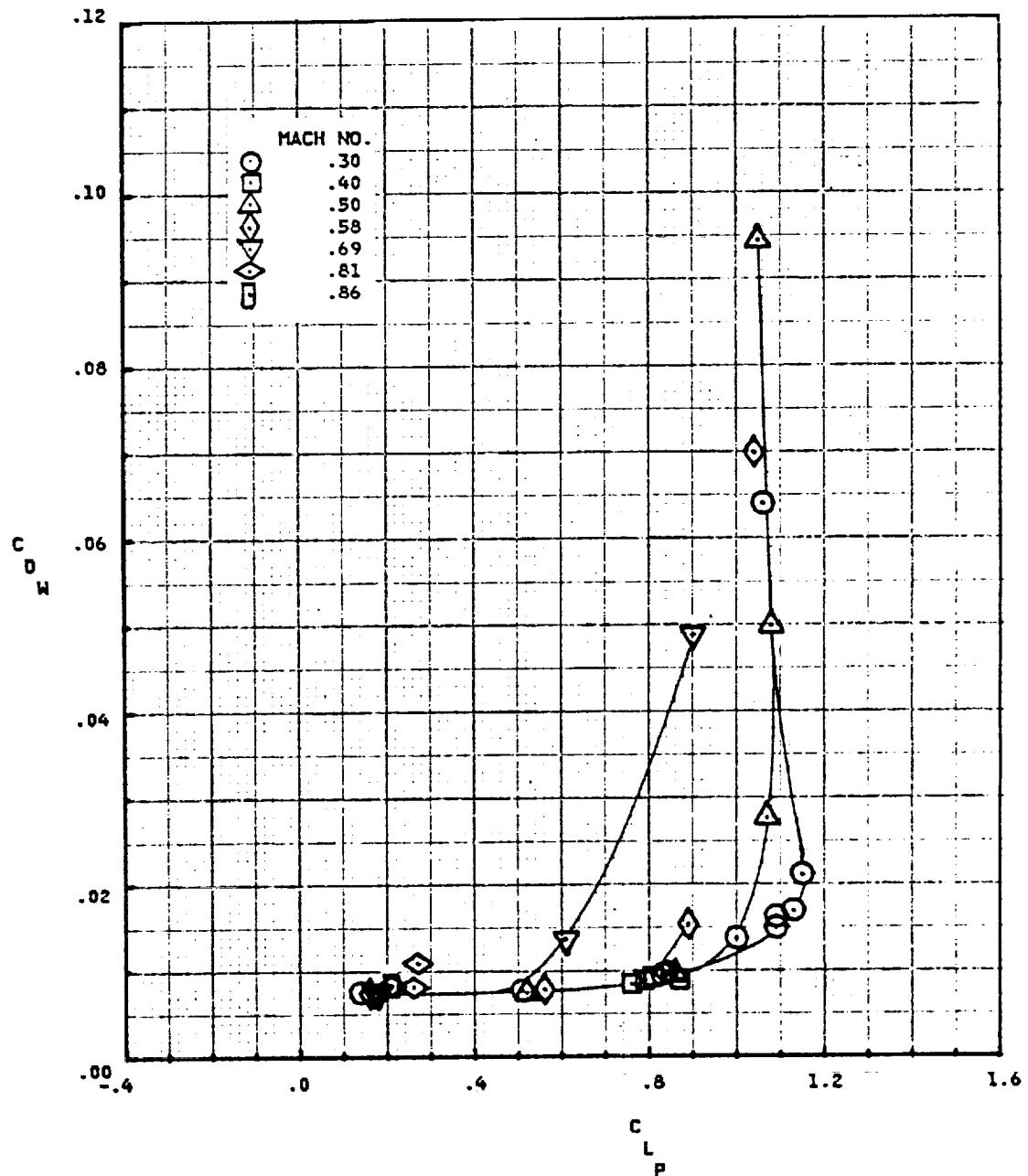
c. Pitching moment coefficient versus lift coefficient
 Figure E-7. (Concluded)

ORIGINAL PAGE IS
OF POOR QUALITY



a. Lift coefficient versus angle of attack

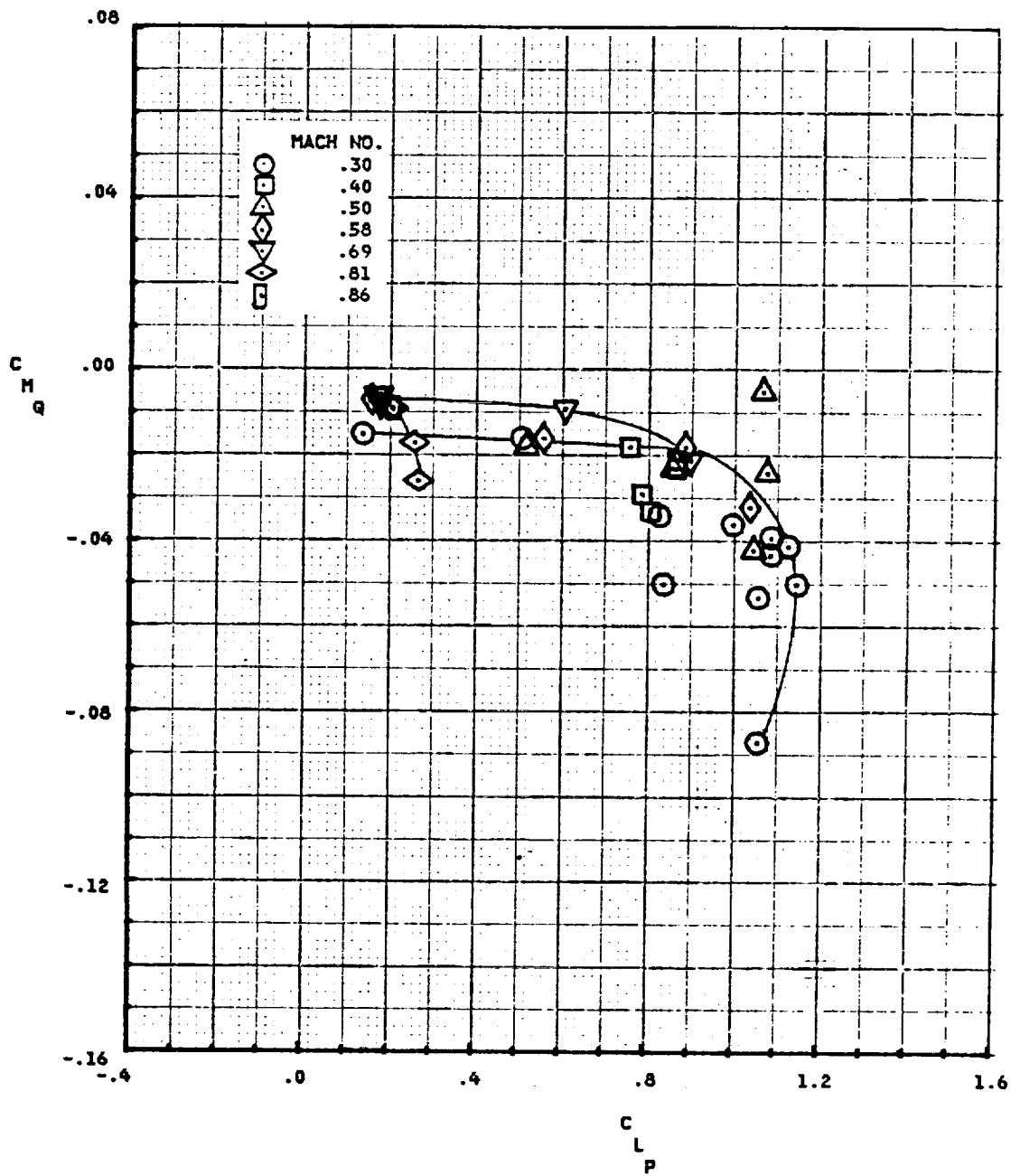
Figure E-8. - Aerodynamic data for the clean SSC-A09 airfoil.



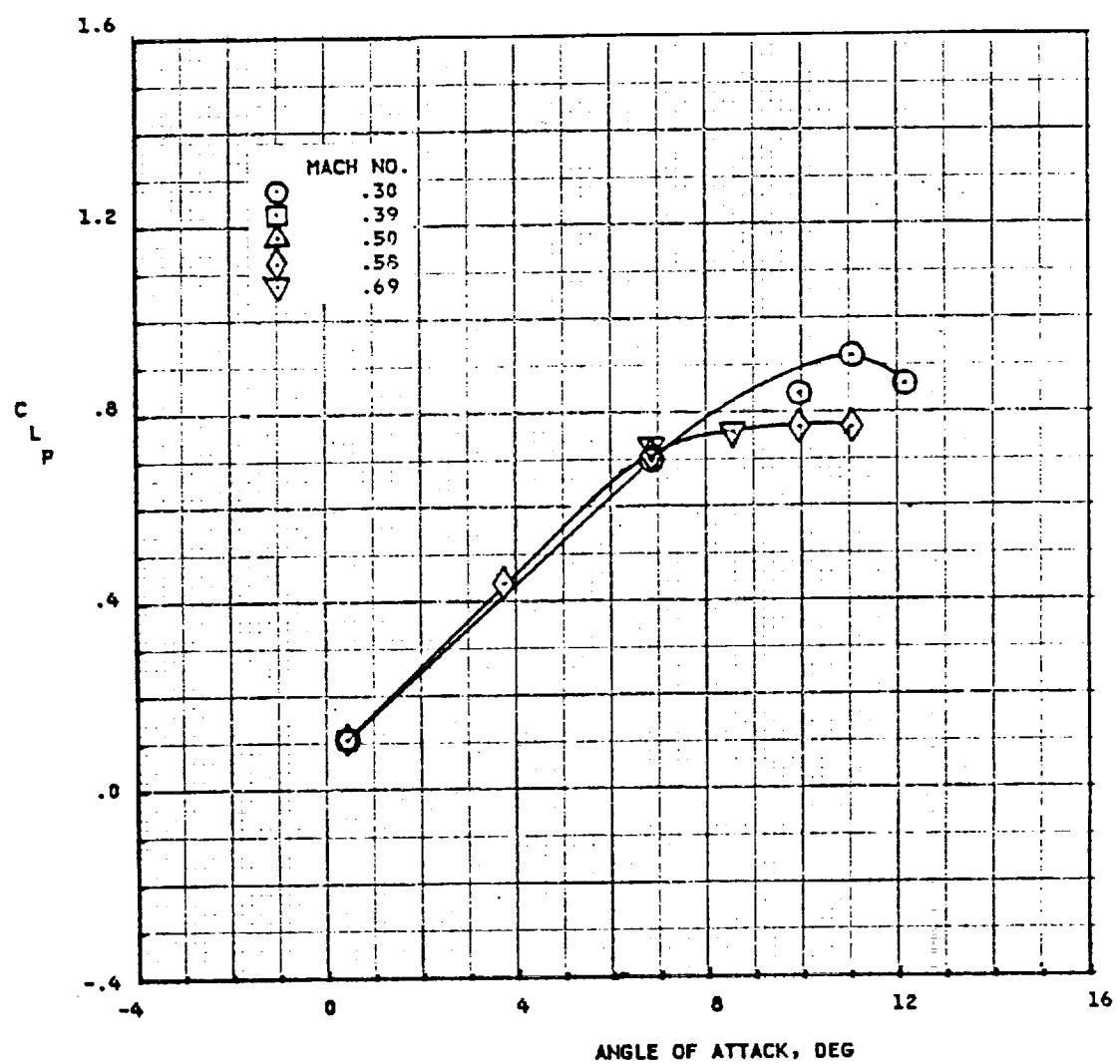
b. Drag coefficient versus lift coefficient

Figure E-8. (Continued)

ORIGINAL PAGE IS
OF POOR QUALITY



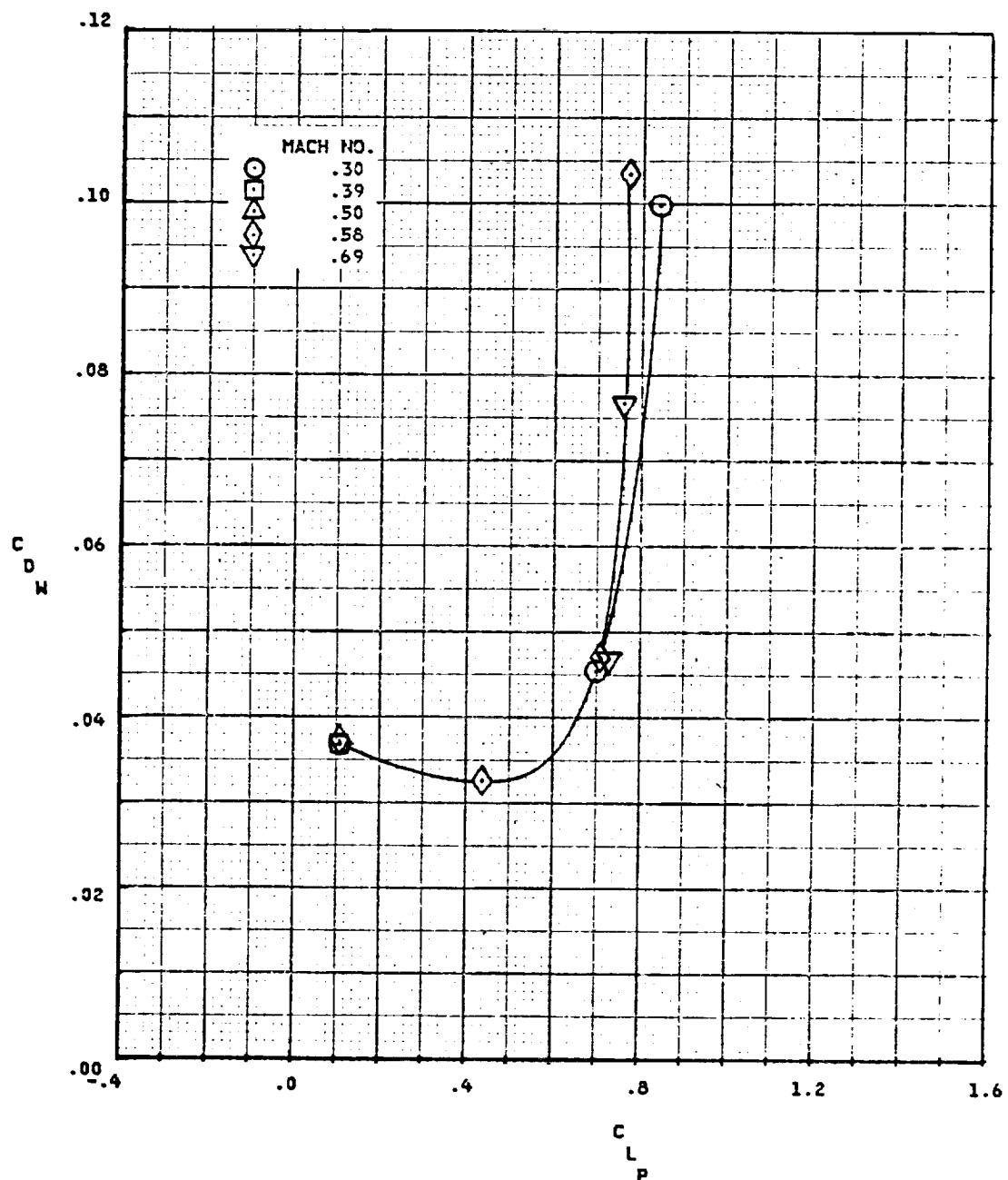
c. Pitching moment coefficient versus lift coefficient
Figure E-8. (Concluded)



a. Lift coefficient versus angle of attack

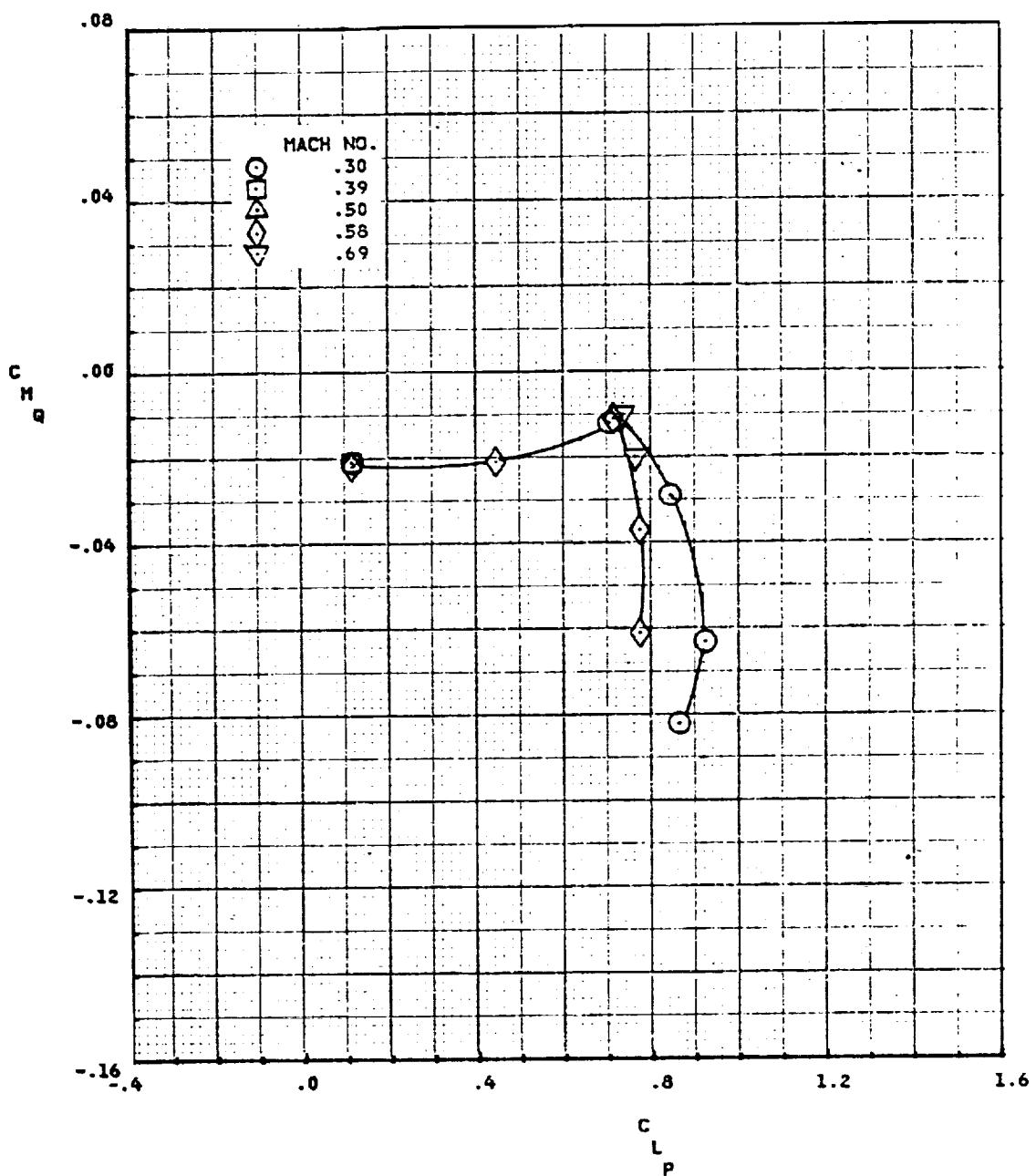
Figure E-9. - Aerodynamic data for the SSC-A09 airfoil with simulated ice number 1.

ORIGINAL PAGE IS
OF POOR QUALITY



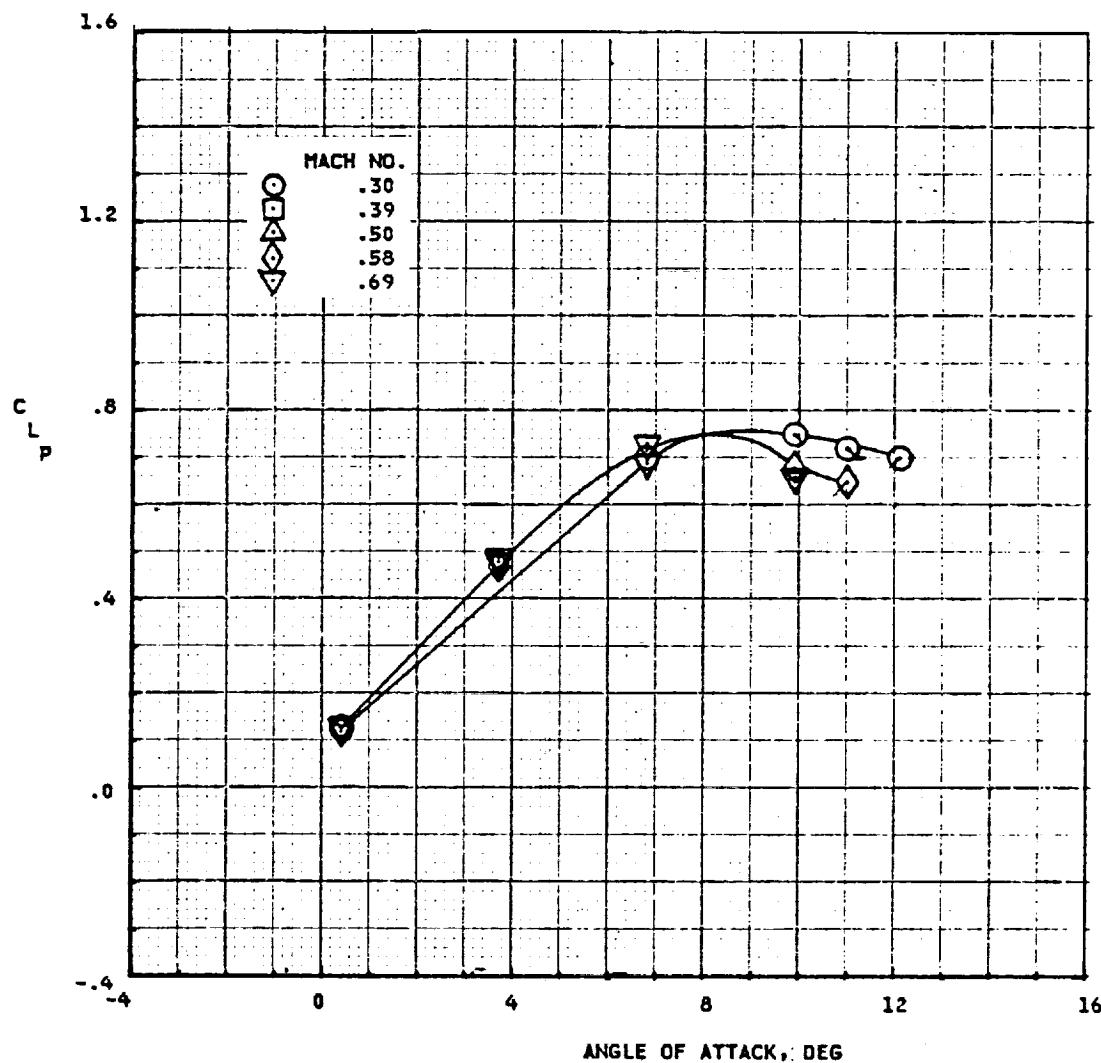
b. Drag coefficient versus lift coefficient

Figure E-9. (Continued)



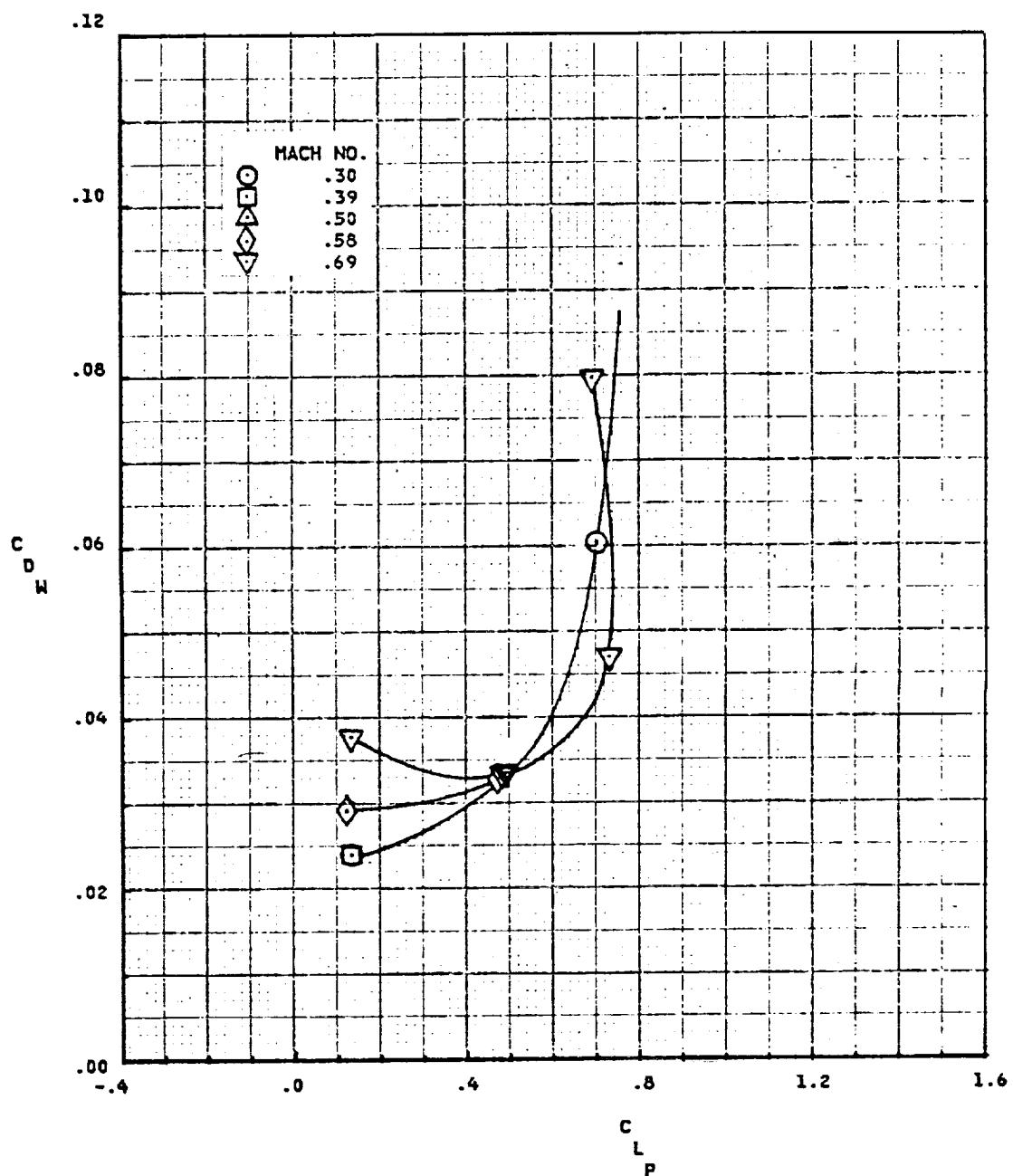
c. Pitching moment coefficient versus lift coefficient
 Figure E-9. (Concluded)

ORIGINAL PAGE IS
OF POOR QUALITY



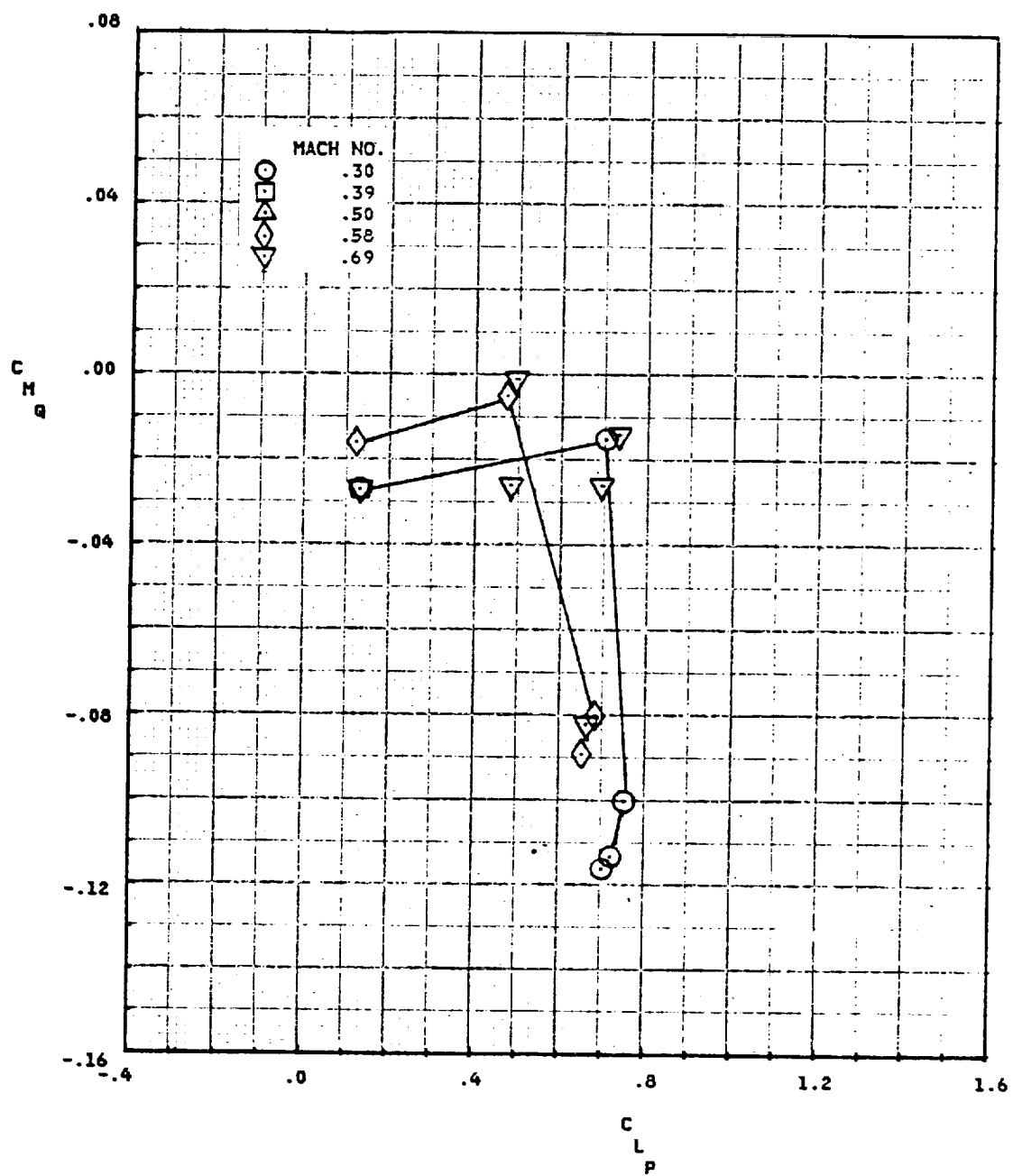
a. Lift coefficient versus angle of attack

Figure E-10. - Aerodynamic data for the SSC-A09 airfoil with simulated ice number 2.

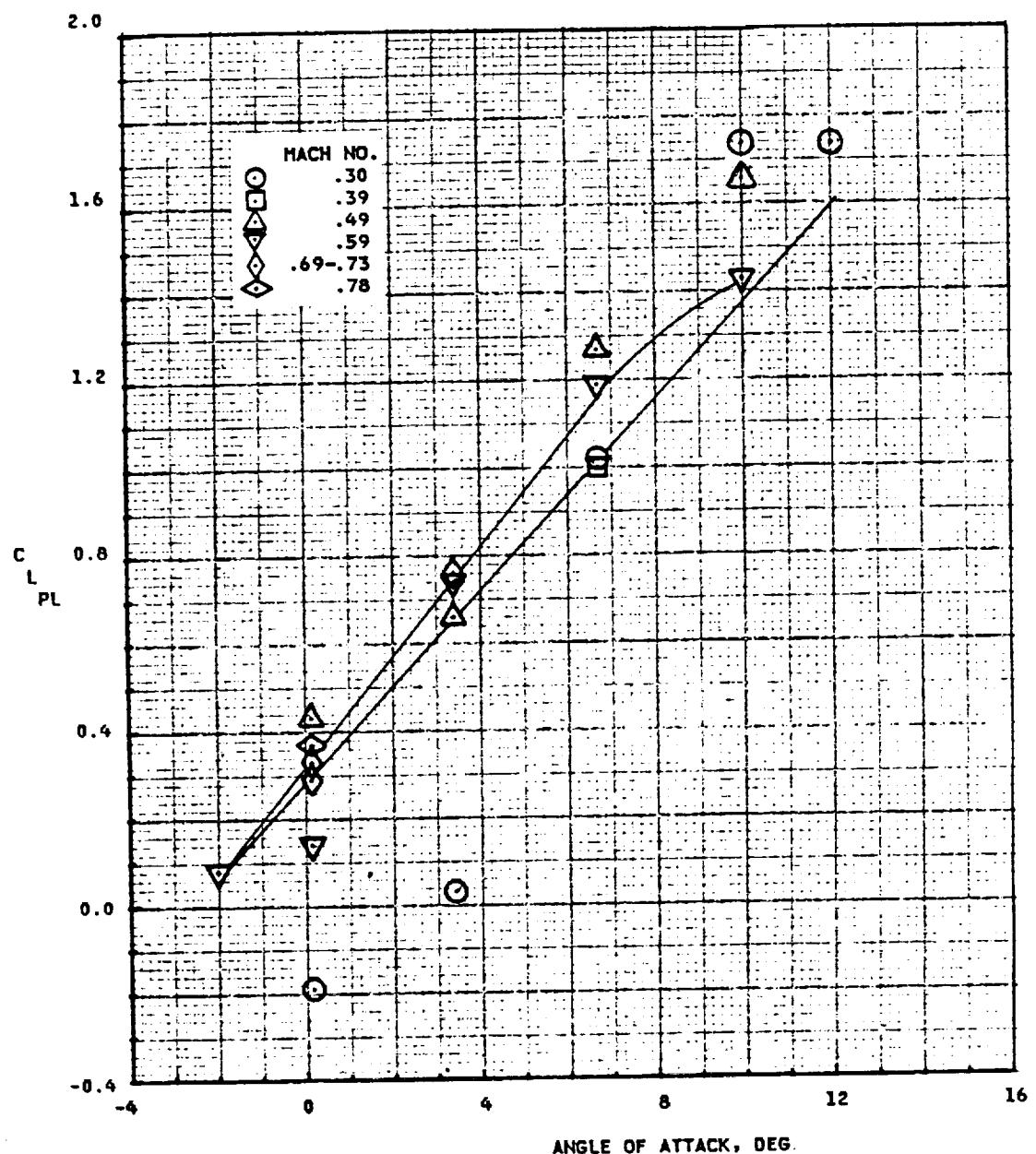


b. Drag coefficient versus lift coefficient
 Figure E-10. (Continued)

ORIGINAL PAGE IS
OF POOR QUALITY



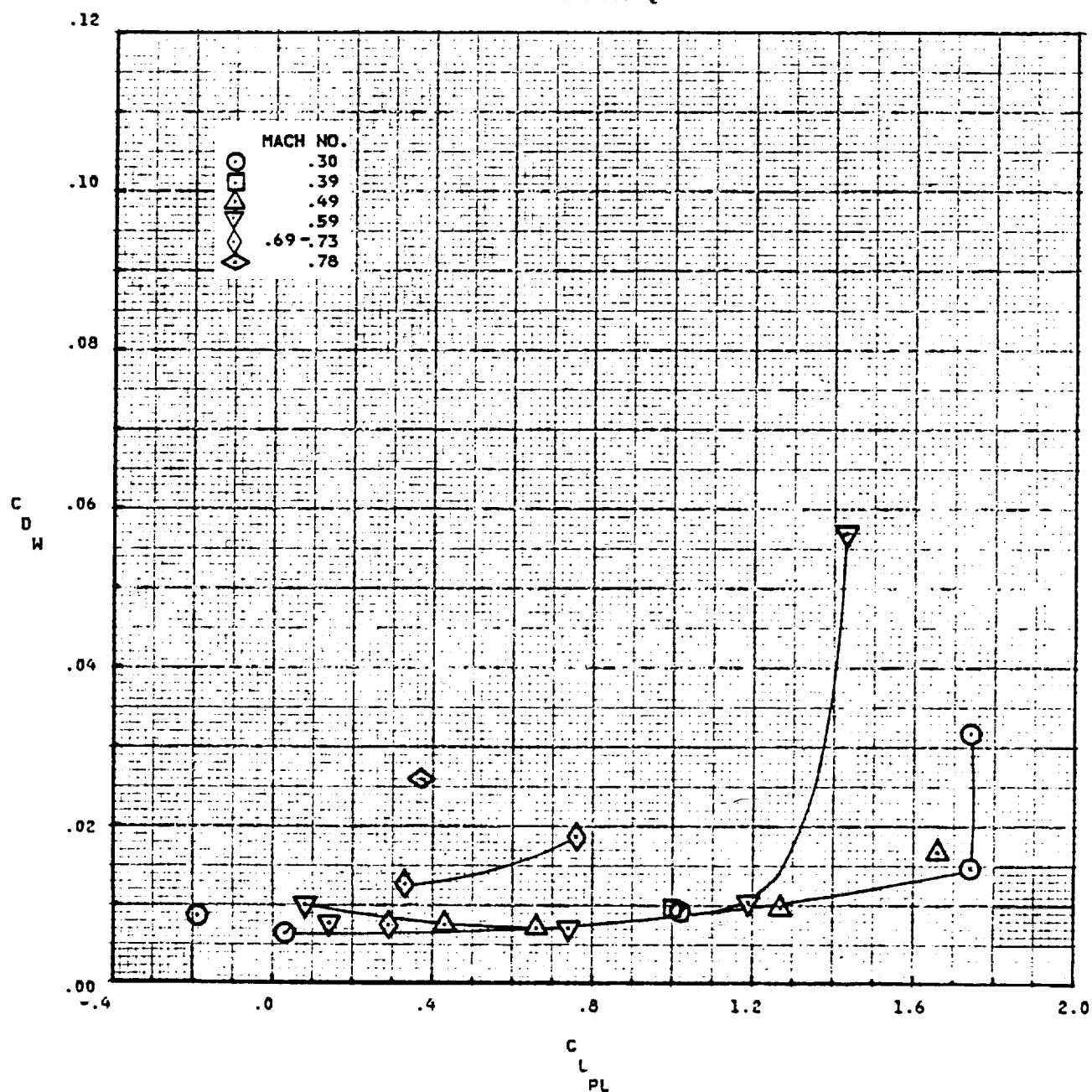
C. Pitching moment coefficient versus lift coefficient
Figure E-10. (Concluded)



a. Lift coefficient versus angle of attack

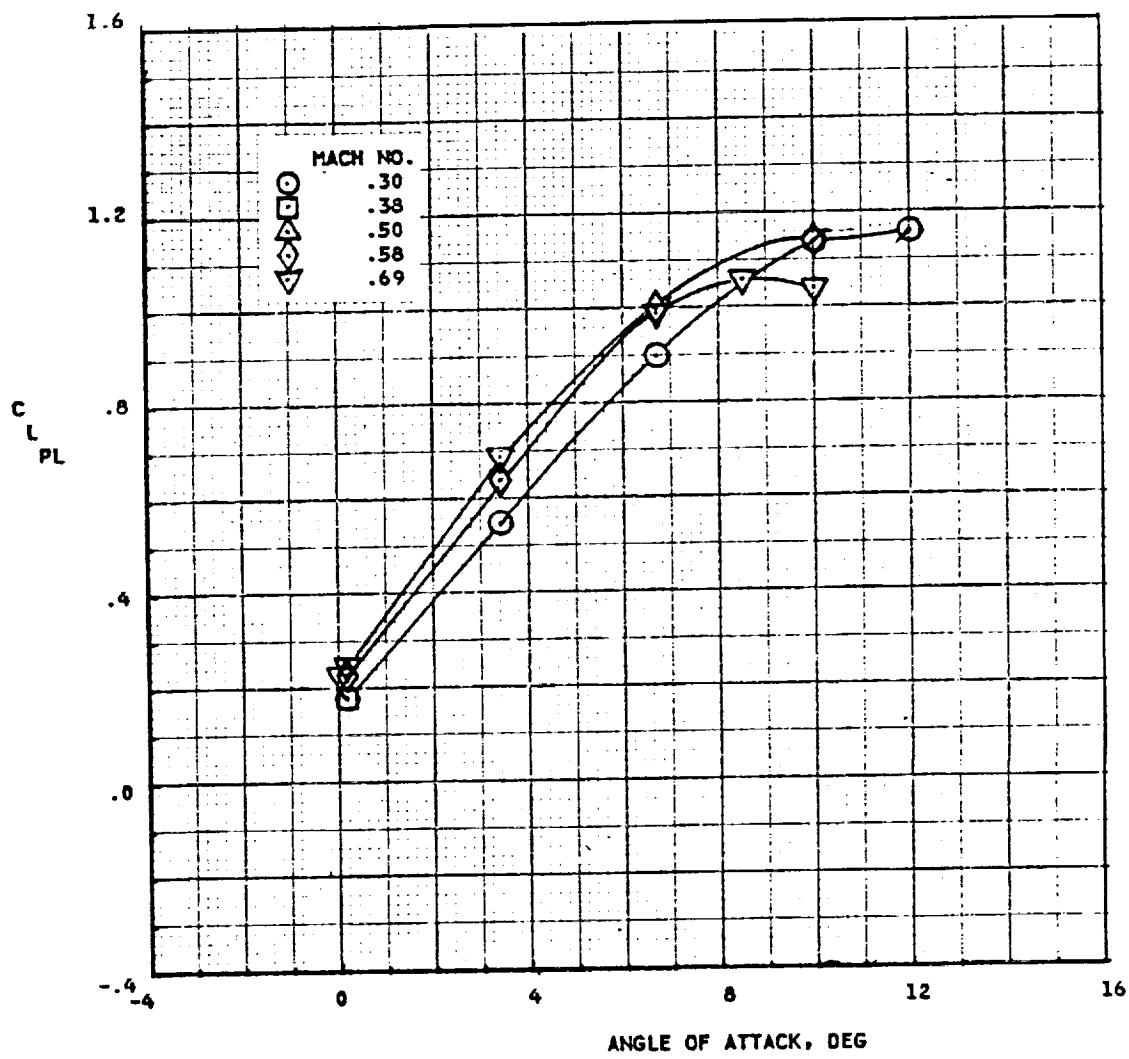
Figure E-11. - Aerodynamic data for the clean VR-7 airfoil.

ORIGINAL PAGE IS
OF POOR QUALITY



b. Drag coefficient versus lift coefficient

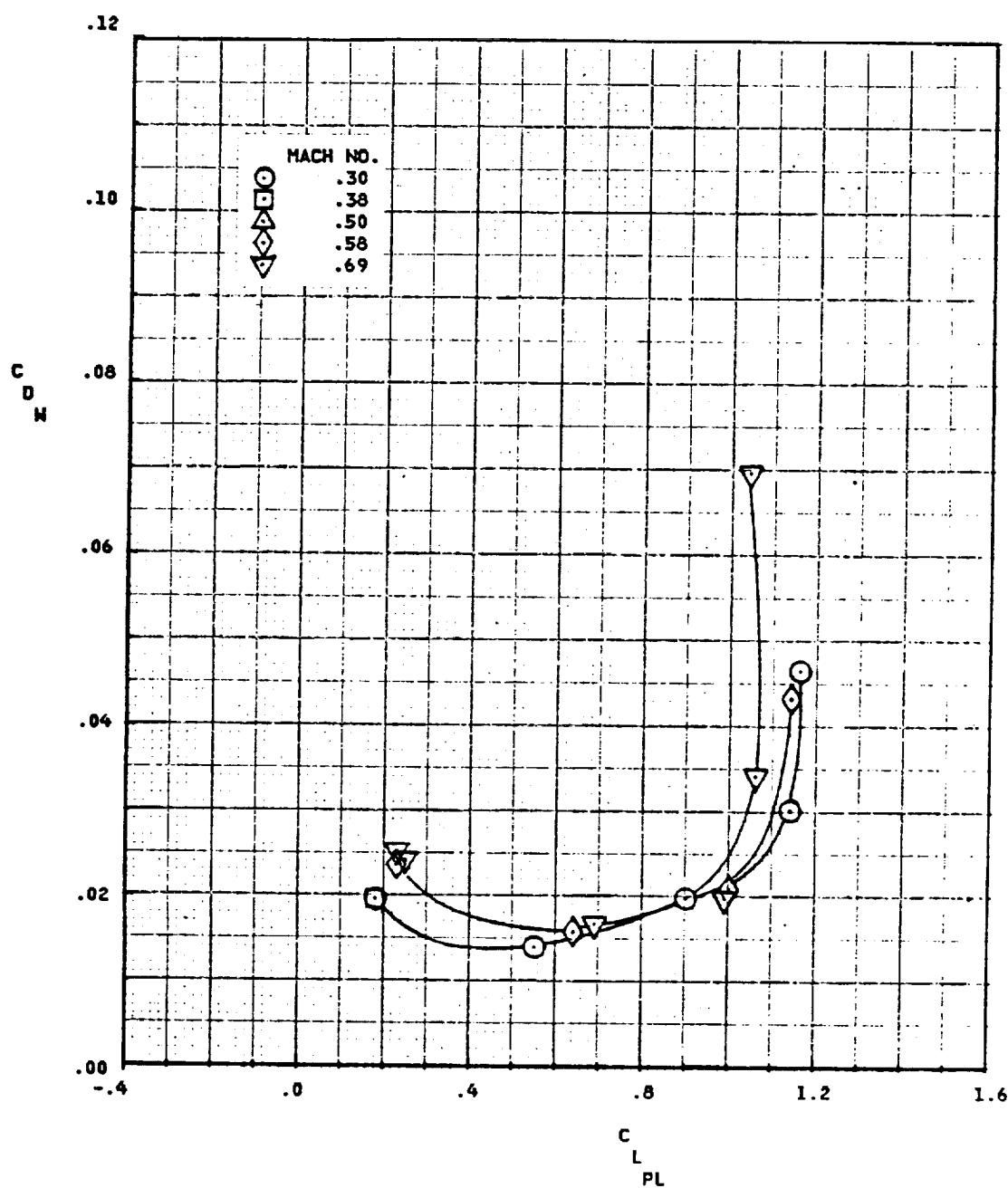
Figure E-11. - (Concluded)



a. Lift coefficient versus angle of attack

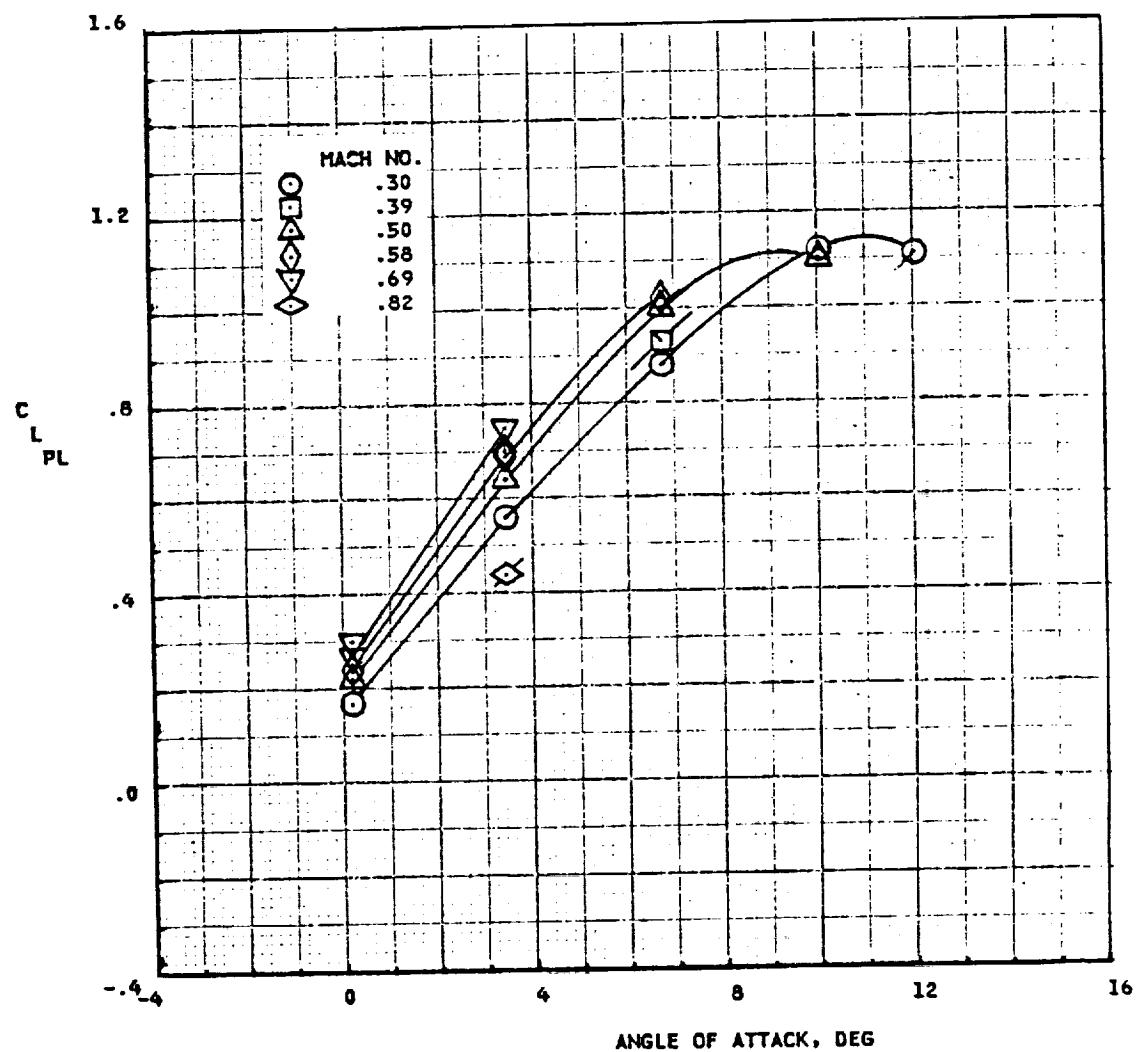
Figure E-12. - Aerodynamic data for the VR-7 airfoil with simulated ice number 1.

ORIGINAL PAGE IS
OF POOR QUALITY.



b. Drag coefficient versus lift coefficient

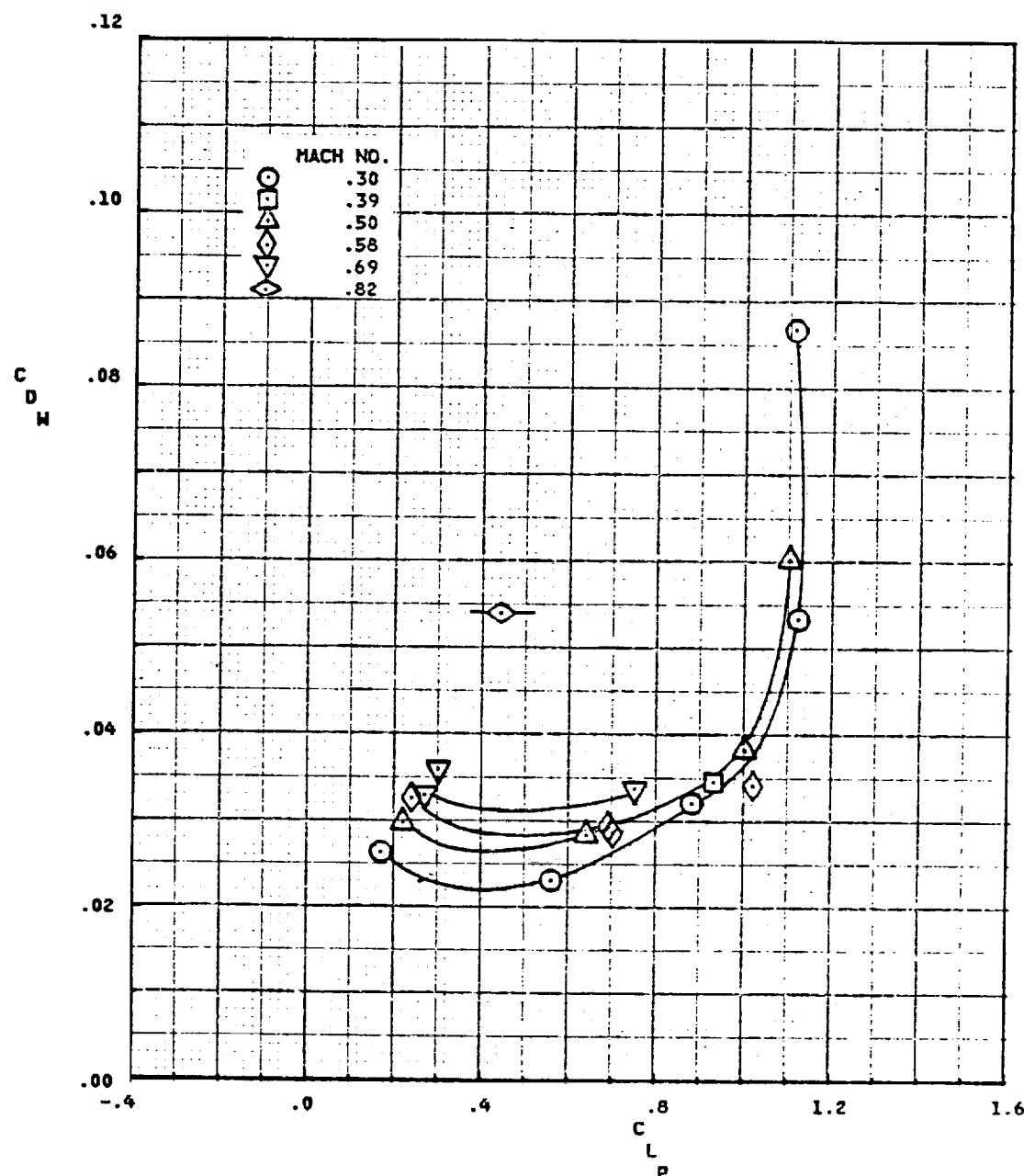
Figure E-12. (Concluded)



a. Lift coefficient versus angle of attack

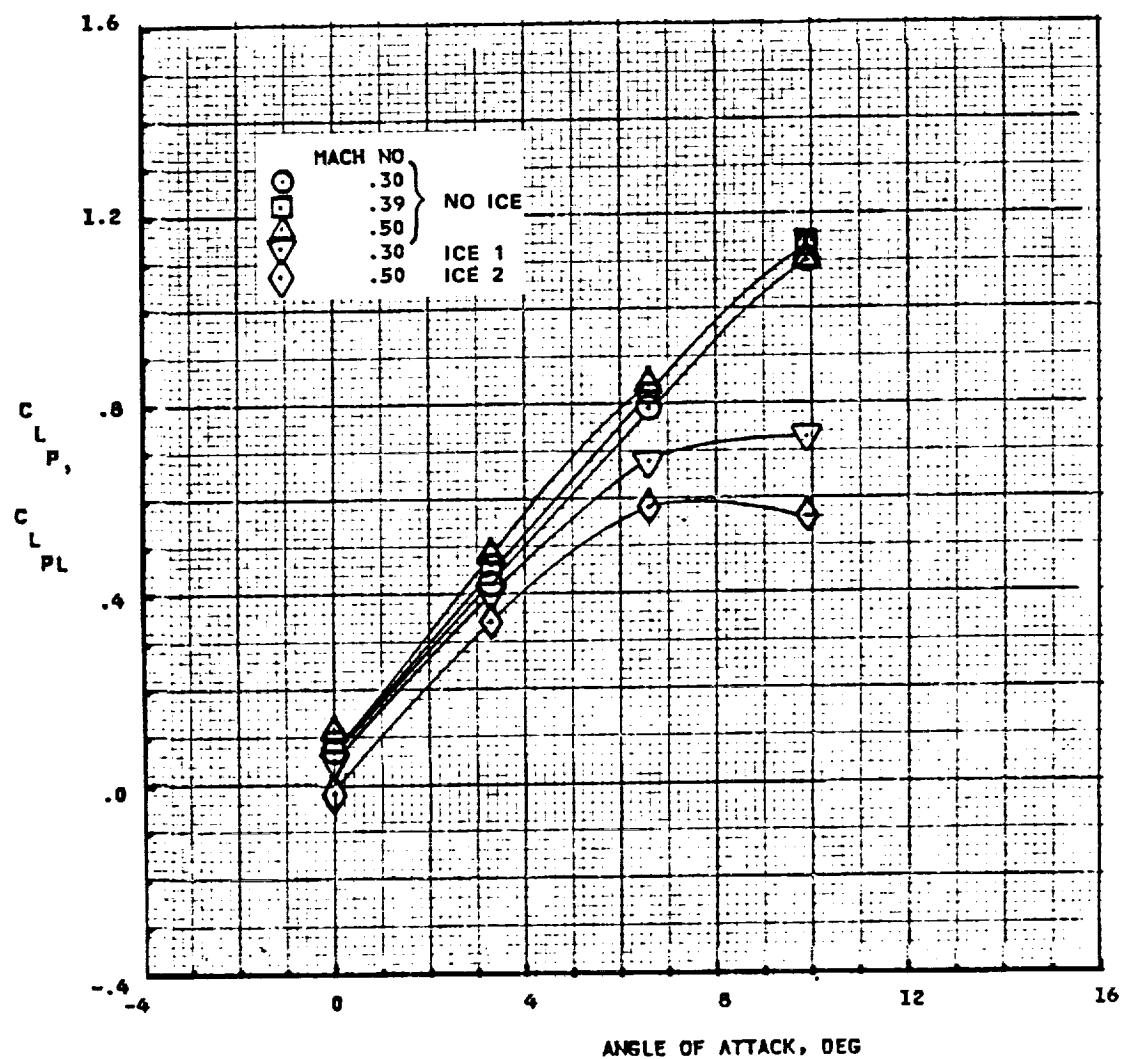
Figure E-13. - Aerodynamic data for the VR-7 airfoil with simulated ice number 2.

ORIGINAL PAGE IS
OF POOR QUALITY



b. Drag coefficient versus lift coefficient

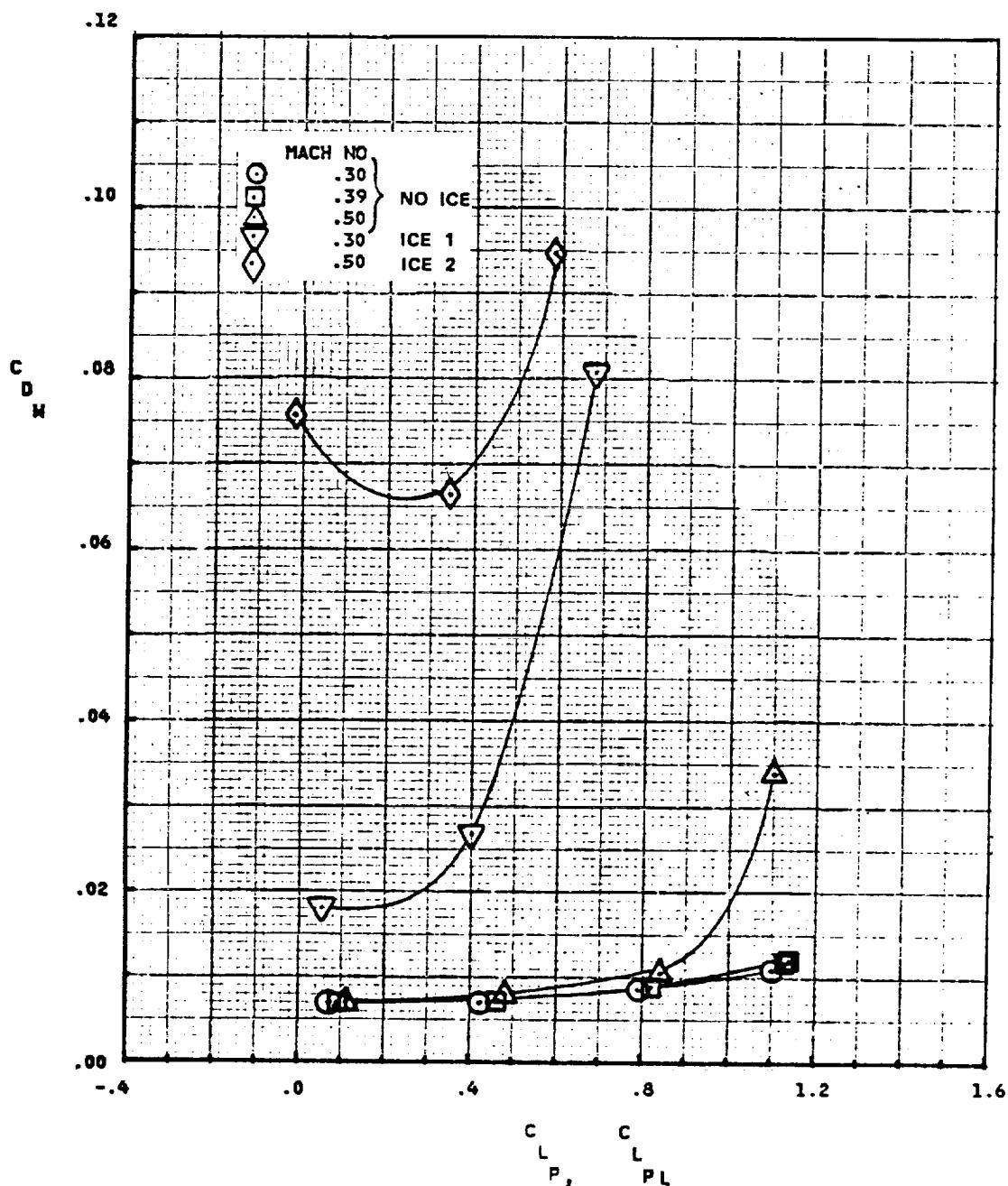
Figure E-13. (Concluded)



a. Lift coefficient versus angle of attack

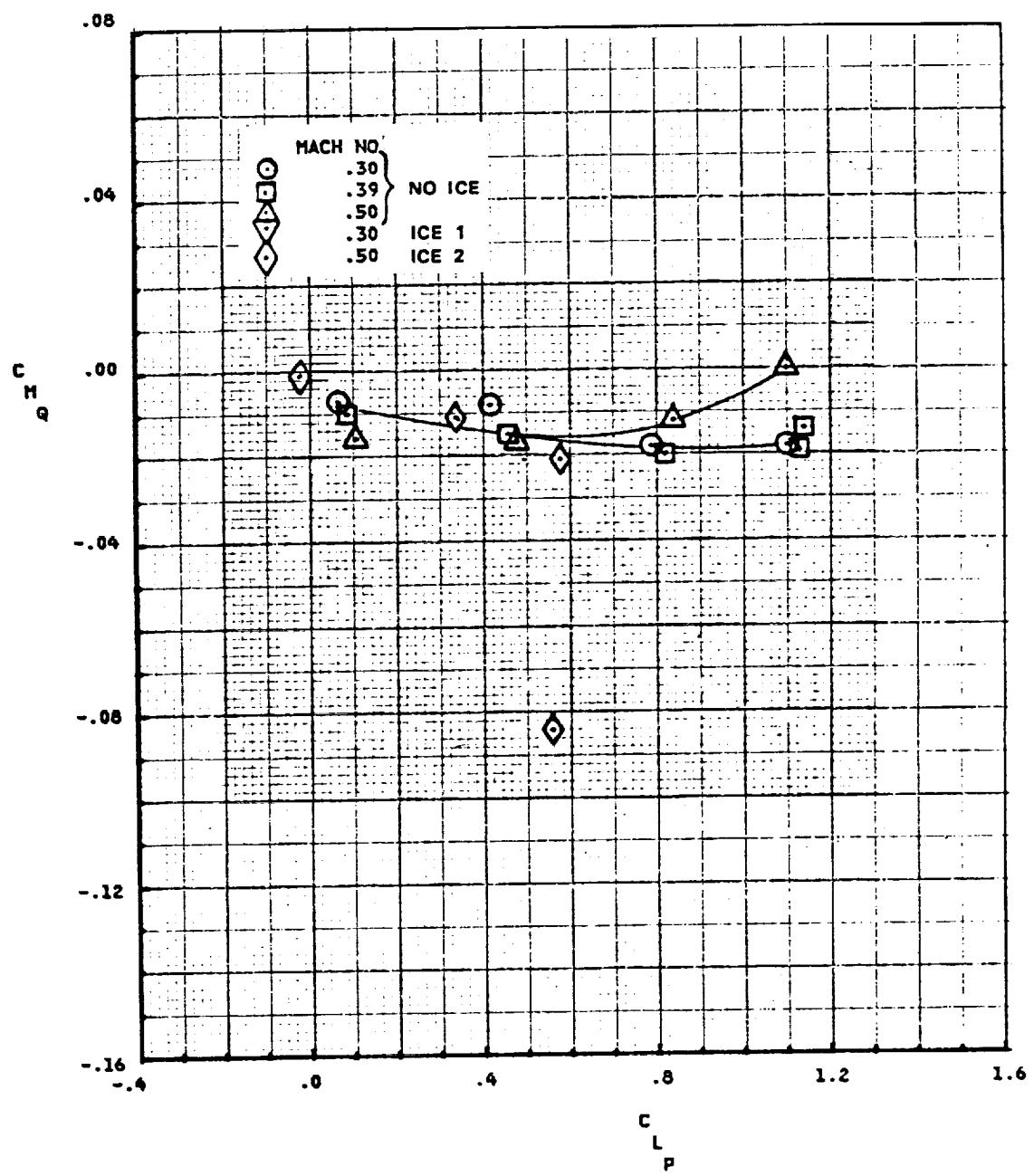
Figure E-14. - Aerodynamic data for the SC1094R8 airfoil with and without simulated ice.

ORIGINAL PAGE IS
OF POOR QUALITY



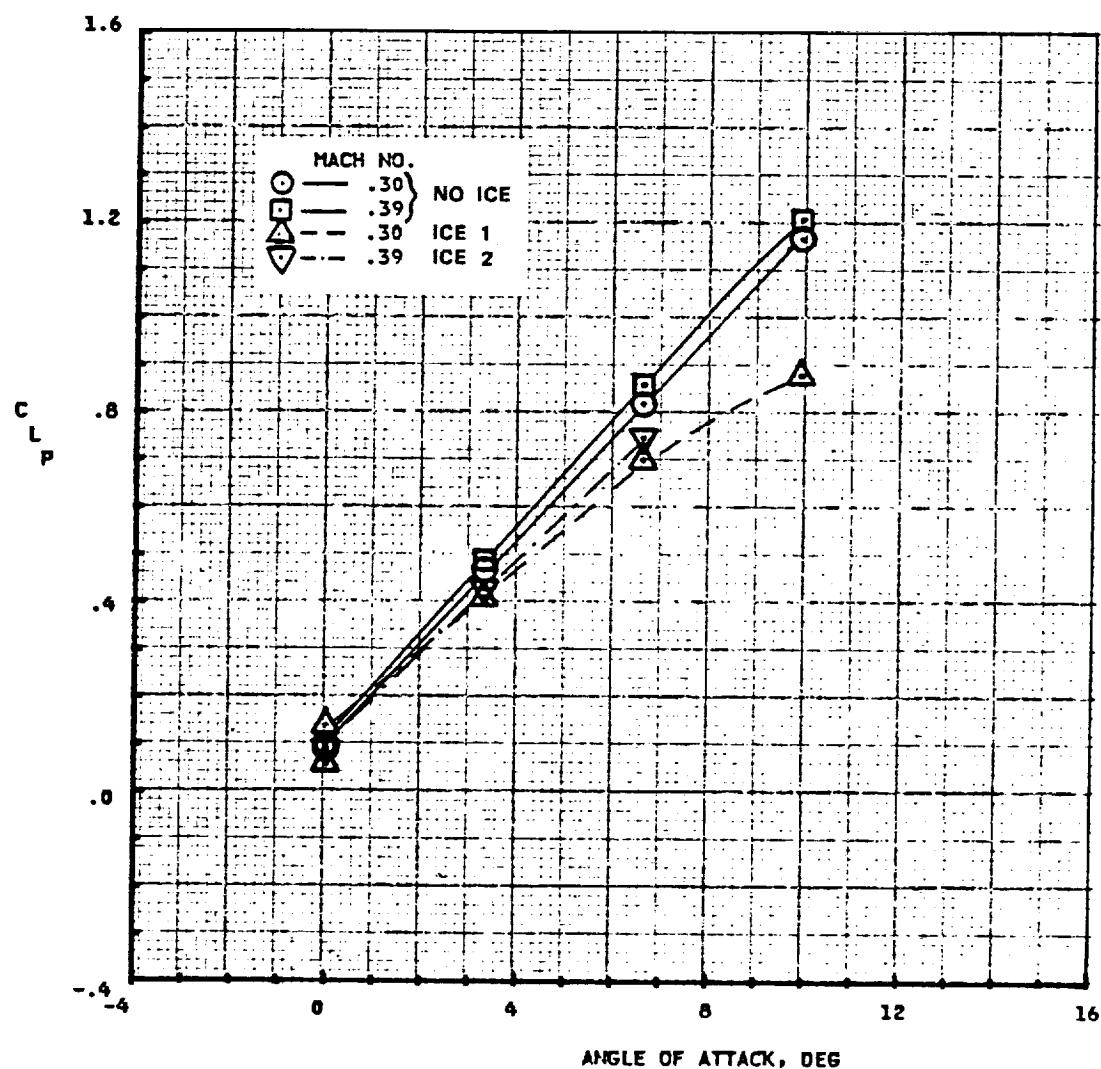
b. Drag coefficient versus lift coefficient

Figure E-14. (Continued)



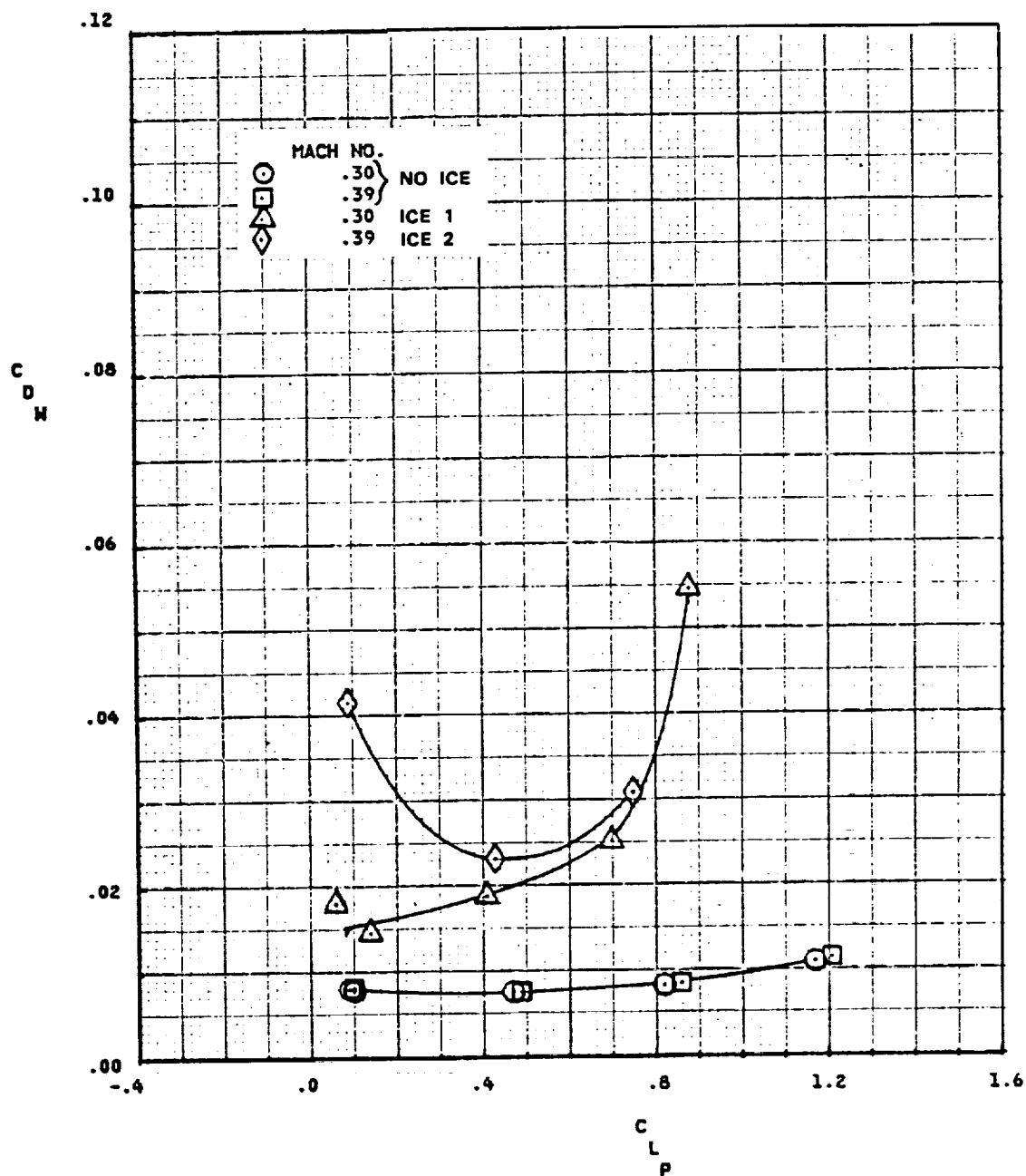
c. Pitching moment coefficient versus lift coefficient
 Figure E-14. (Concluded)

ORIGINAL PAGE IS
OF POOR QUALITY



a. Lift coefficient versus angle of attack

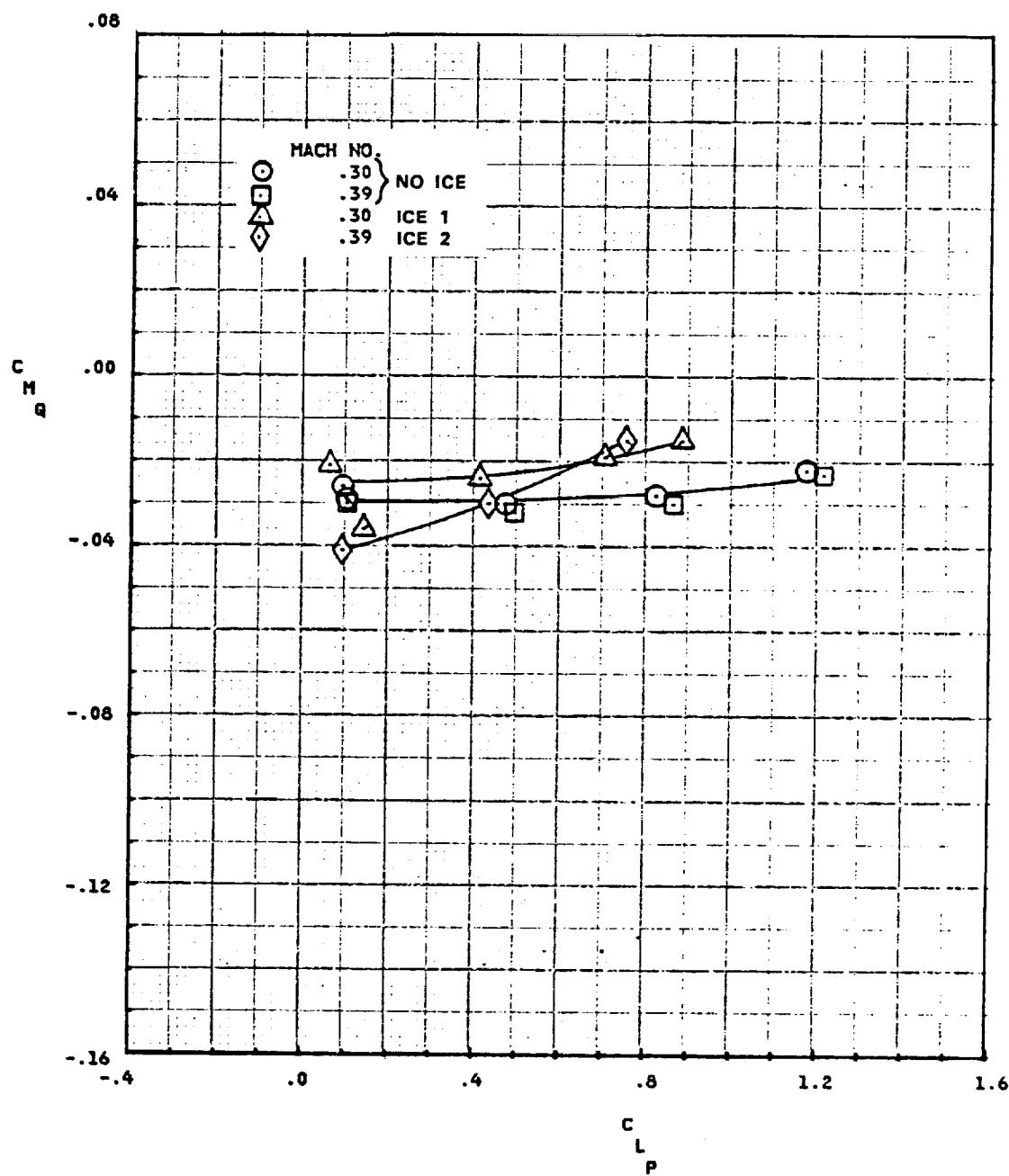
Figure E-15. - Aerodynamic data for the SC1012R8 airfoil with and without simulated ice.



b. Drag coefficient versus lift coefficient

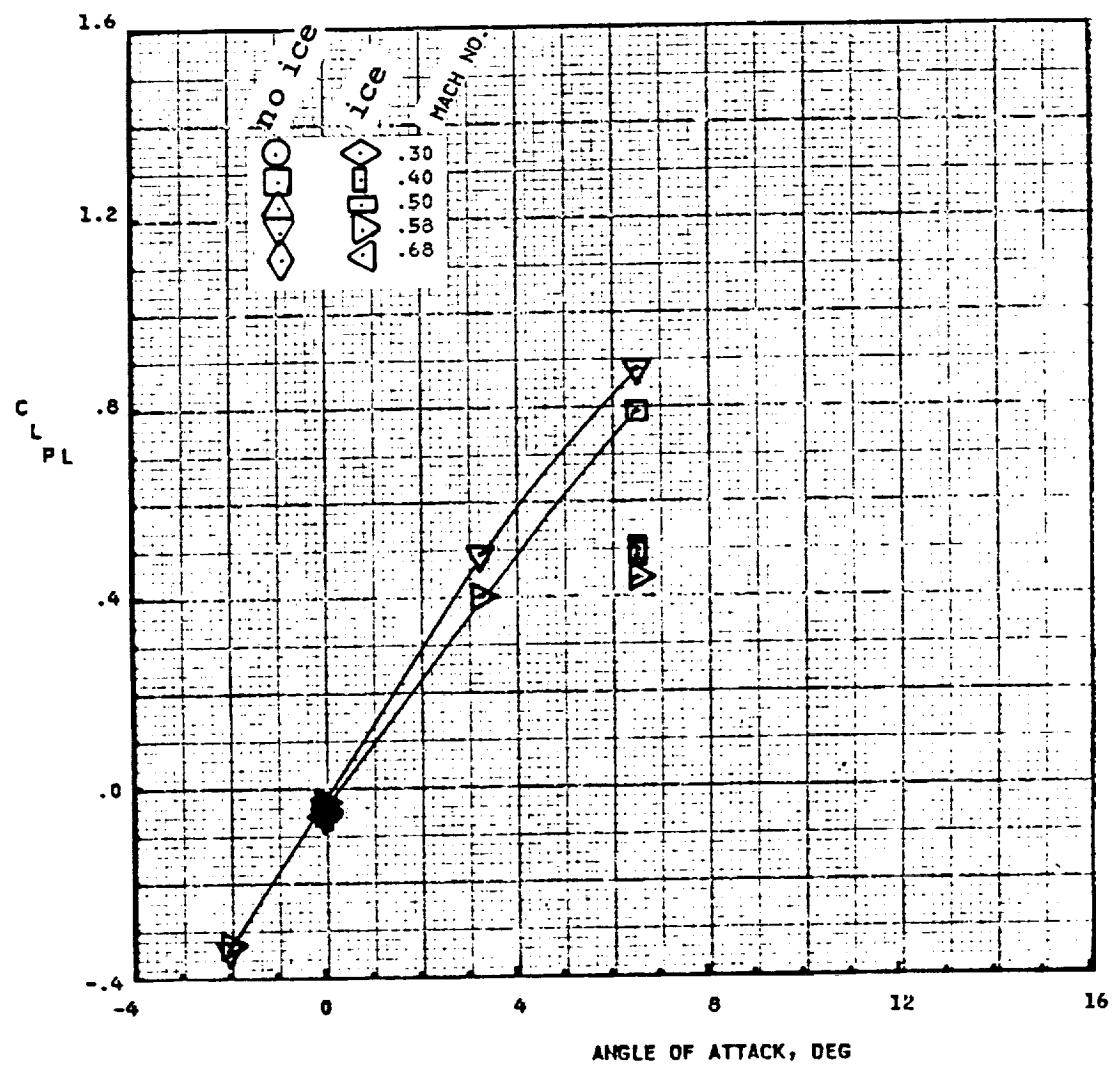
Figure E-15. - (Continued)

ORIGINAL PAGE IS
OF POOR QUALITY



c. Pitching moment coefficient versus lift coefficient

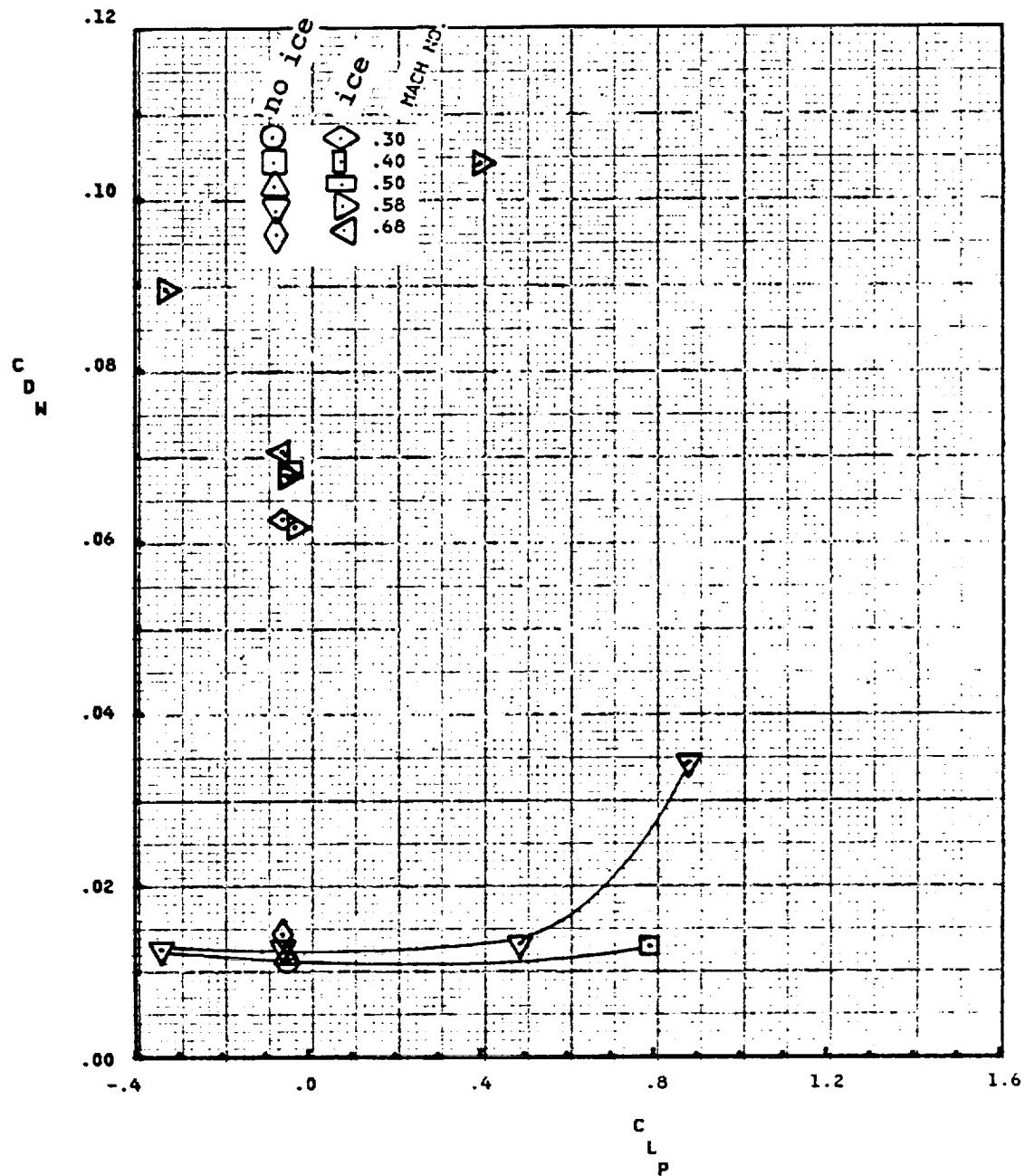
Figure E-15. - (Concluded)



a. Lift coefficient versus angle of attack

Figure E-16. - Aerodynamic data for the OH-58 Tail Rotor with and without simulated ice.

ORIGINAL PAGE IS
OF POOR QUALITY



b. Drag coefficient versus lift coefficient

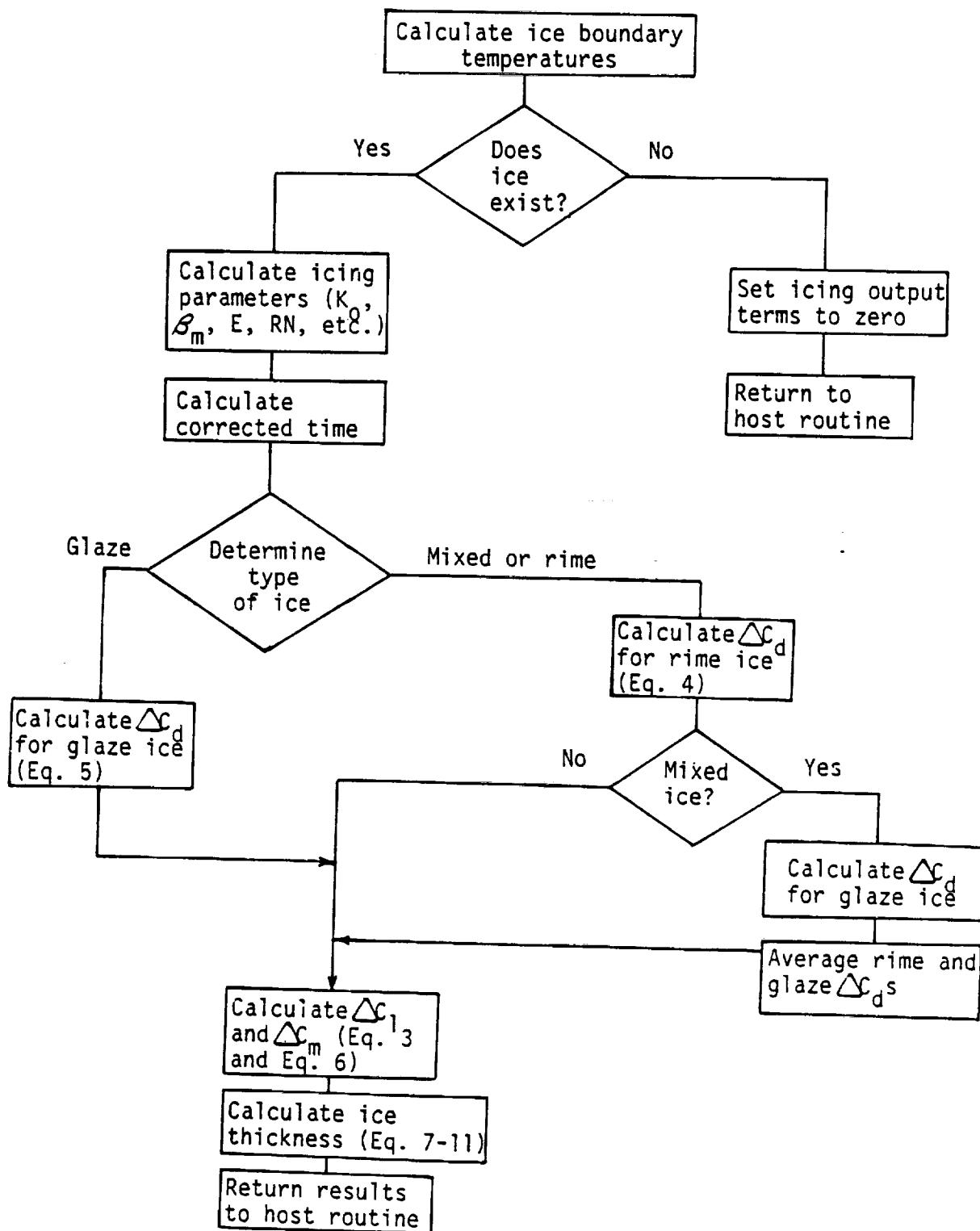
Figure E-16. - (Concluded)

APPENDIX F

Two-Dimensional Airfoil Icing Prediction Code

The computer code for the prediction of ice thickness and incremental lift, drag, and pitching moment coefficients is contained in this appendix. This code is presented in subroutine form. A program to test this subroutine and test case output is also contained in this appendix.

APPENDIX F (CONT)

SIMPLIFIED FLOW DIAGRAM
SUBROUTINE TO COMPUTE AIRFOIL ICING INCREMENTS

APPENDIX F (CONT)

```

C SUBROUTINE ICING
C WRITTEN BY R. FLEMMING, JUNE 1984, CONTRACT NAS3-23049
C PURPOSE: TO CALCULATE ICE LIFT, DRAG, AND PITCHING MOMENT INCREMENTS
C AND ICE THICKNESS.
C
C SUBROUTINE INPUTS
C
C CHORD    AIRFOIL CHORD (METERS)
C TOC      AIRFOIL THICKNESS TO CHORD RATIO (DECIMAL)
C ROC      AIRFOIL LEADING EDGE RADIUS TO CHORD RATIO (DECIMAL)
C ALF      AIRFOIL ANGLE OF ATTACK (DEGREES)
C CDBASE   CLEAN AIRFOIL DRAG COEFFICIENT
C TS       STATIC TEMPERATURE (DEGREES C)
C M        MACH NUMBER -- INPUT AS ZERO TO INPUT VMPS
C VMPS    VELOCITY (MPS) NOTE EITHER M OR VMPS MAY BE INPUT
C ALT     PRESSURE ALTITUDE (M)
C W        LIQUID WATER CONTENT (G/CU M)
C DD      MEAN VOLUME DROPLET DIAMETER (MICRONS)
C TAU     ICING TIME (SECONDS)
C CTAU    CORRECTED ICING TIME
C OSC     OSCILLATION (=0. FOR NO OSCILLATION, =1. FOR OSCILLATION)
C VHELO   HELICOPTER FLIGHT SPEED (KM/HOUR)
C CLOUD   CLOUD LOWER TEMPERATURE LIMIT CRITERIA
C          =1. FOR NO LIMIT
C          =2. FOR FAR 25 INTERMITTENT MAXIMUM LIMIT
C          =3. FOR FAR 25 MAXIMUM CONTINUOUS LIMIT
C          =4. FOR DOT/FAA/CT-83/22 LIMIT
C
C SUBROUTINE OUTPUTS
C
C DELCL   PREDICTED LIFT INCREMENT
C DELCD   PREDICTED DRAG INCREMENT
C DELCM   PREDICTED PITCHING MOMENT INCREMENT
C THK     PREDICTED ICE THICKNESS (M)
C AC      ACCUMULATION PARAMETER
C AKZERO  MODIFIED INERTIA PARAMETER
C TONSET  ONSET OF ICE TEMPERATURE (DEGREES C)
C TGLAZE  BOUNDARY TEMPERATURE BETWEEN BEAK AND DOUBLE HORN ICE
C          (DEGREES C)
C TRIME   BOUNDARY TEMPERATURE BETWEEN RIME AND WET GROWTH ICE
C          (DEGREES C)

C
C SUBROUTINE ICING
COMMON /AIRF/CHORD,TOC,ROC,ALF,CDBASE,OSC,VHELO,CLOUD
COMMON /ATMOS/TS,M,VMPS,ALT
COMMON /ICE/W,DD,TAU
COMMON /OUT1/DELCL,DELCD,DELCM,THK
COMMON /OUT2/AC,AKZERO,TONSET,TGLAZE,TRIME
REAL M,KOC,KD,KD1,KL,KL1
TSK=TS+273.15
IF (M.LT..1)M=VMPS/(20.04679*SQRT(TSK))
C CALCULATE ICE BOUNDARIES
REC=.0944*M*W**2+.385*M*W+.98*M**3-1.33*M-.0283*W**2-.115*W+1.077
TONSET=273.15/(1.+.2*REC*M**2)-273.15+.33*(ALF-6.)
TGLAZE=TONSET-.33*ALF
IF(ALF.LE.0.)TGLAZE=TONSET
TRIME=(224.79*W**2-326.25*W+35.59)*M**2-(83.05*W**2-
1 57.73*W+26.38)*M
C CLOUD HIGH TEMPERATURE CRITERIA
IF(TS.GE.TONSET)GO TO 50
C CLOUD LOW TEMPERATURE CRITERIA
ICLOUD=INT(CLOUD+.001)
IF(ICLOUD.LT.1.OR.ICLOUD.GT.4)ICLOUD=1

```

APPENDIX F (CONT)

```

IF(VHELO.LT.1.)ICLOUD=1
EXTENT=VHELO*TAU/3600.
GO TO (40,10,20,30),ICLOUD
10 F=-.0328*(ALCG(EXTENT))*2-.1649*ALOG(EXTENT)+1.1875
WMAX=F*(-.000875*TS**2+.03125*TS+2.9)
IF(W.LE.WMAX)GO TO 40
GO TO 50
20 F=-.3040*ALOG(EXTENT)+1.87
WMAX=F*(0.8-.02*TS)
IF(W.LE.WMAX)GO TO 40
GO TO 50
30 IF(TS.GE.-15..AND.W.LE.1.74)GO TO 40
IF(TS.LT.-15..AND.TS.GE.-20..AND.W.LE.0.66)GO TO 40
IF(TS.LT.-20..AND.TS.GE.-25..AND.W.LE.0.41)GO TO 40
GO TO 50
40 VEL=M*20.04679*SQRT(TSK)
TT=-273.15+TSK*(1+.2*M**2)
RHOICE=880000.
SIG=1000.
DELT=00/1000000.
KOC=.001
G=9.80665-3.10E-6*ALT
POPO=(1.-.6875586*ALT*3.2808*10E-06)**5.255853
RHOA=.12492*POPO*288.15/TSK
HMU=1.5002E-07*TSK**1.5/(TSK+114)
DROPRN=RHOA*VEL*DELT/HMU
SCA=CHORD/.1524
VISC=G*HMU
AK=SIG*DELT**2*VEL/(18.*CHORD*VISC)
C CALCULATE KO BASED ON BRAGG EQN 21
AKZERO=AK/(1.+.0967*DRCPRN**.6367)
C CALCULATE IMPINGEMENT EFFICIENCIES BASED ON EMPIRICAL CURVE FITS
ALNK0=ALOG(AKZERO)
BETAM=.1423*ALNK0-25.13*TOC**2+1.772*TOC+1.2645
IF(BETAM.GT.1.)BETAM=1.
EM=.5600+0.08686*ALNK0+.6111*TOC**2-.7433*TOC
C CALCULATE CORRECTED TIME
TAUFTR=1.0/EXP(.00139*TAU)
CTAU=TAU*TAUFTR
IF(TAU.GE.600.)CTAU=260.+49.77*(ALOG(TAU)-6.379)
AC=VEL*W*CTAU/(RHOICE*CHORD)
CDSAVE=0.
IF(TS.GE.TRIME+2.)GO TO 60
C RIME DRAG CALCULATIONS
IF(CDBASE.GT..0210)CDBASE=.0210
DELCD=CDBASE*((.158*ALOG(KOC)+175.0*AC*EM*SCA**.2/SCA**1.2+1.70)
1*(ALF+6.)/10.
IF(TS.GT.TRIME-2.)CDSAVE=DELCD
IF(TS.GT.TRIME-2.)GO TO 60
GO TO 80
C NO ICING
50 DELCL=0.
DELCD=0.
DELCM=0.
THK=0.
AKZERO=0.
AC=0.
RETURN
C GLAZE ICING DRAG (INCLUDING BEAK ICE)
60 KD=0.
KD1=1.
IF(TS.GT.(TGLAZE-8.).AND.TS.LT.TGLAZE)KD=((TS-TGLAZE+8.)/8.)*2
IF(TS.GE.TGLAZE.AND.TS.LT.TONSET)KD=1.
IF(TS.GE.TGLAZE.AND.TS.LT.TONSET)KD1=(TS-TONSET)/(TONSET-TGLAZE)
DCDTMP=KD*.006*M**2.4
DELCD=KD1*((.00686*AKZERO*TOC**1.5*(ALF+6.))+DCDTMP-
1.0313*ROC**2)*W*CTAU*SCA**.2/SCA**1.2

```

APPENDIX F (CONT)

```

IF(TS.GE.TRIME+2)GO TO 80
DELCD=CDSAVE-(DELCD-CDSAVE)*(TRIME-2.-TS)/4.
C GLAZE AND RIME DELTA CL AND DELTA CM
80 KL=0.67
KL1=1.
IF(ALF.LE.6.)KLI=0.
IF(TS.GT.TRIME.AND.TS.LT.TGLAZE)KL=.67*(1.+(TS-TRIME)/(TGLAZE
1 -TRIME))
IF(TS.GE.TGLAZE.AND.TS.LT.TONSET)KL=1.33*(1.-(TS-TGLAZE)/(TONSET
1 -TGLAZE))
DELCL=-.01335*AKZERO*TOC*(ALF+2.)+KL1*.00555*(ALF-6.)**2)*KL
1 *W*CTAU*SCA**.2/SCA**1.2
DELCM=((.00179-.0045*M)*.000544*AKZERO*ALF/TOC**2.7
1 +.000383*M*(1.-63.29*ROC))*CTAU*W*SCA**.2/SCA**1.2
C OSCILLATION EFFECTS
DELCL = DELCL*(1.0.*OSC*VHELO/278.)
OSCDCD=8.*DELCD*OSC*VHELO/278.
IF(OSCDCD.GT.0.4)OSCDCD=0.4
DELCD = DELCD*(1-OSCDCD)
DELCM = DELCM*1.
C ICE THICKNESS CALCULATIONS
IF(TRIME.GE.TONSET)REFRRC=.66
IF(TRIME.GE.TONSET)GO TO 90
REFRC1=(TS-TONSET)/(TRIME-TONSET)
REFRRC1=1.0-.9242*EXP(-REFRC1)
IF(REFRRC.GT.1.)REFRRC=1.
IF(REFRRC.LT.0.)REFRRC=0.
90 AP=REFRRC*W*CTAU*VEL*TOC*CHORD*BETAM/RHOICE
IF (TS.LT.TGLAZE)GO TO 100
BASE=.2*REFRRC
THK=4.*AP/(BASE*CHORD)
RETURN
100 AREA=.01854*TOC
AFTHK=.7968*TOC
AALE=.00435/M
FST=(AFTHK*.08-AREA+AFTHK*AALE)*CHORD**2
IF(AP.GT.FST)GO TO 110
A1=568.136*AALE**2-28.776*AALE+.437
B1=-131.142*AALE**2+4.846*AALE+.010
X=(-B1+SQRT(B1**2+4.*A1*AP/CHORD**2))/2./A1
THK=(X*TOC*CHORD/.095)*EXP(-.3067*REFRRC)
GO TO 120
110 THK=(AP+AREA*CHORD**2)/(AFTHK*CHORD)
C EMPIRICAL THICKNESS CORRECTION
120 CTHK=-.0018
IF(THK.LT..00254)CTHK=-.709*THK
THK=(THK+CTHK)/(1.0-.00426/TOC**2.1)
RETURN

C PROGRAM: ICETST
C
C WRITTEN BY: R. FLEMMING 5/84
C
C PURPOSE: TO TEST SUBROUTINE "ICING"
C
C
C SUBROUTINE INPUTS
C
C      CHORD    AIRFOIL CHORD (METERS)
C      TOC     AIRFOIL THICKNESS TO CHORD RATIO (DECIMAL)
C      ROC     AIRFOIL LEADING EDGE RADIUS TO CHORD RATIO (DECIMAL)
C      ALF     AIRFOIL ANGLE OF ATTACK (DEGREES)
C      CDBASE   CLEAN AIRFOIL DRAG COEFFICIENT
C      TS      STATIC TEMPERATURE (DEGREES C)
C      M       MACH NUMBER -- INPUT AS ZERO TO INPUT VMPS

```

CHAPTER II - APPENDIX F
OF POOR QUALITY

APPENDIX F (CONT)

```

C   VMPS    VELOCITY (MPS) NOTE EITHER M OR VMPS MAY BE INPUT
C   ALT     PRESSURE ALTITUDE
C   W      LIQUID WATER CONTENT (G/CU M)
C   DD     MEAN VOLUME DROPLET DIAMETER (MICRONS)
C   TAU    ICING TIME (SECONDS)
C   OSC    OSCILLATION (=0. FOR NO OSCILLATION, =1. FOR OSCILLATION)
C   VHELO   HELICOPTER FLIGHT SPEED (KM/HOUR)
C   CLOUD   CLOUD LOWER TEMPERATURE LIMIT CRITERIA
C           =1. FOR NO LIMIT
C           =2. FOR FAR 25 INTERMITTENT MAXIMUM LIMIT
C           =3. FOR FAR 25 MAXIMUM CONTINUOUS LIMIT
C           =4. FOR DOT/FAA/CT-83/22 LIMIT
C
C   SUBROUTINE OUTPUTS
C
C   DELCL   PREDICTED LIFT INCREMENT
C   DELCD   PREDICTED DRAG INCREMENT
C   DELCM   PREDICTED PITCHING MOMENT INCREMENT
C   THKF    PREDICTED ICE THICKNESS
C   AC      ACCUMULATION PARAMETER
C   AKZERO  MODIFIED INERTIA PARAMETER
C   TONSET  ONSET OF ICE TEMPERATURE (DEGREES C)
C   TGLAZE  BOUNDARY TEMPERATURE BETWEEN BEAK AND DOUBLE HORN ICE
C           (DEGREES C)
C   TRIME   BOUNDARY TEMPERATURE BETWEEN RIME AND WET GROWTH ICE
C           (DEGREES C)
C
COMMON /AIRF/CHORD,TOC,ROC,ALF,CDBASE,OSC,VHELO,CLOUD
COMMON /ATMOS/TS,M,VMPS,ALT
COMMON /ICE/W,DD,TAU
COMMON /OUT1/DELCL,DELCD,DELCM,THK
COMMON /OUT2/AC,AKZERO,TONSET,TGLAZE,TRIME
REAL M
WRITE(6,2)
2 FORMAT('   T STATIC      LWC      DELCL      DELCD      DELCM      T
1HK      AC      K0      T ONSET      T GLAZE      T RIME'
2           DEG C      G/CU M
3M           DEG C      DEG C      DEG C')/
CHORD=.1524
TOC=.12
ROC=.0158
ALF=6.
CDBASE=.0085
OSC=0.
VHELO=0.
CLOUD=1.
TS=-12.
ALT=0.
M=.39
VMPS=0.
DD=20.
TAU=60.
DO 5 J=1,7
W=.25+(J-1)*.25
CALL ICING
WRITE(6,10)TS,W,DELCL,DELCD,DELCM,THK
1 ,AC,AKZERO,TONSET,TGLAZE,TRIME
10 FORMAT(1H ,2F10.2,6F10.4,3F10.2)
5 CONTINUE
W=.75
DO 6 J=1,16
TS=-30.+(J-1)*2.
CALL ICING
WRITE(6,10)TS,W,DELCL,DELCD,DELCM,THK
1 ,AC,AKZERO,TONSET,TGLAZE,TRIME
6 CONTINUE
STOP
END

```

APPENDIX F (CONT)

T STATIC DEG C	LNC 6/CU M	DELCL	DELCD	DELCH	THK M	K0	T ONSET DEG C	T GLAZE DEG C	T RIME DEG C
-12.00	0.25	-0.0340	0.0148	0.0001	0.0020	0.0130	0.2870	-5.10	-7.08
-12.00	0.50	-0.1056	0.0596	0.0003	0.0039	0.0260	0.2870	-5.19	-7.17
-12.00	0.75	-0.1755	0.0446	0.0004	0.0051	0.0390	0.2870	-5.28	-7.26
-12.00	1.00	-0.2444	0.0599	0.0006	0.0060	0.0520	0.2870	-5.38	-7.36
-12.00	1.25	-0.3130	0.0753	0.0007	0.0068	0.0650	0.2870	-5.49	-7.47
-12.00	1.50	-0.3815	0.0911	0.0008	0.0075	0.0780	0.2870	-5.60	-7.58
-12.00	1.75	-0.4500	0.1071	0.0010	0.0081	0.0910	0.2870	-5.73	-7.71
-30.00	0.75	-0.0998	0.0310	0.0004	0.0103	0.0376	0.2807	-5.28	-7.26
-26.00	0.75	-0.1000	0.0311	0.0004	0.0101	0.0378	0.2814	-5.28	-7.26
-26.00	0.75	-0.1003	0.0316	0.0004	0.0098	0.0379	0.2821	-5.28	-7.26
-24.00	0.75	-0.1017	0.0360	0.0004	0.0094	0.0381	0.2828	-5.28	-7.26
-22.00	0.75	-0.1138	0.0398	0.0004	0.0090	0.0382	0.2835	-5.28	-7.26
-20.00	0.75	-0.1261	0.0399	0.0004	0.0084	0.0384	0.2842	-5.28	-7.26
-18.00	0.75	-0.1383	0.0400	0.0004	0.0078	0.0386	0.2849	-5.28	-7.26
-16.00	0.75	-0.1507	0.0401	0.0004	0.0071	0.0387	0.2856	-5.28	-7.26
-14.00	0.75	-0.1630	0.0409	0.0004	0.0062	0.0389	0.2863	-5.28	-7.26
-12.00	0.75	-0.1755	0.0446	0.0004	0.0051	0.0390	0.2870	-5.28	-7.26
-10.00	0.75	-0.1880	0.0516	0.0004	0.0038	0.0392	0.2877	-5.28	-7.26
-8.00	0.75	-0.2005	0.0619	0.0004	0.0021	0.0393	0.2884	-5.28	-7.26
-6.00	0.75	-0.0745	0.0243	0.0004	0.0135	0.0394	0.2890	-5.28	-7.26
-4.00	0.75	0.0	0.0	0.0	0.0	0.0	0.0	-5.28	-7.26
-2.00	0.75	0.0	0.0	0.0	0.0	0.0	0.0	-5.28	-7.26
0.0	0.75	0.0	0.0	0.0	0.0	0.0	0.0	-5.28	-7.26

APPENDIX F (CONT)

GLAZE

CHORD = .1524

TOC = .12

ROC = .0158

ALF = 6.

CDBASE = .0085

OSC = 0.

VHELO = 0.

CLOUD = 1.

TS = -12.0

M = .39

W = .75

DD = 20.

TAU = 60.

ALT = 0.

TSK = 261.15

REC = $f(M, W) = .65$

TONSET = $f(REC, M, ALF) = -5.28$

TGLAZE = $f(TONSET, ALF) = -7.26$

TRIME = $f(M, W) = -24.19$

VEL = $f(M, TSK) = 126.34$

TT = -4.06

RHOICE = 880,000

SIG = 1,000

DELT = $f(DD) = .000\ 02$

KOC = .001

G = 9.8067

POPØ = 1.0

RHOA = .1378

HMU = .0000017

DROPRN = 206.4

SCA = 1.0

VISC = .0000166

APPENDIX F (CONT)

AK = f(SIG, DELT, VEL, CHORD, VISC) = 1.11
 AKZERO = f(AK, DROPRN) = .287
 ALNKØ = -1.25
 BETAM = f(ALNKØ, TOC) = .94
 EM = f(ALNKØ, TOC) = .37
 TAUFR = f(TAU) = .92
 CTAU = f(TAU, TAUFR) = 55.2
 AC = f(VEL, W, CTAU, RHOICE, CHORD) = .039
 KD = f(TS, TGLAZE) = .1657
 KD1 = 1.0
 DCDTEMP = f(KD, M) = .0001
 DELCD = KD1 * [(.00686 * AKZERO * TOC ** 1.5 * (ALF + 6.) + DCDTEMP -
 .0313 * ROC ** 2) * W * CTAU * SCA ** .2/SCA ** 1.2]
 = 1 [(.00686 * .287 * .12^{1.5} * 12 + .0001
 - .0313 * .0158²) * (.75 * 55.2 * 1)
 = .0446
 KL1 = 0
 KL = 1.15
 DELCL = -.01335 * AKZERO * TOC * [(ALF + 2) + KL1 * .00555 * (ALF - 6) ** 2]
 * KL * W * CTAU * SCA ** .2/SCA ** 1.2
 = -.01335 * .287 * .12 * (8 + 0 * .00555 * 0²)
 * 1.15 * .75 * 55.2 * 1
 = -.1755
 DELCM = [(.00179 - .0045 * M) * .000544 * AKZERO * ALF/TOC ** 2.7
 + .000383 * M * (1-63.29 * ROC)] * CTAU * W * SCA ** .2/SCA ** 1.2
 = [(.00179 - .0045 * (.39) + .000544 * .287 * 6/.12^{2.7}
 + .000383 * .39 * (1-63.29 * .0158)] * 55.2 * .75 * 1
 = .0004
 FREFC1 = f(TS, TONSET, TRIME) = .36
 FREFRC = f(FREFC1) = .35
 AP = f(FREFRC, W, CTAU, VEL, TOC, CHORD, BETAM, RHOICE)
 = .0000359

APPENDIX F (CONT)

AREA = f(TOC) = .0022
 AFTHK = f(TOC) = .0956
 AALE = f(M) = .0112
 FST = f(AFTHK, AREA, AALE, CHORD) = .0002
 A1 = f(AALE) = .1867
 B1 = f(AALE) = .0477
 X = f(A1, B1, CHORD, AP) = .0291
 THK' = f(X, TOC, CHORD, FREFRC) = .0050
 CTHK = -.0018
 THK = .0051

MIXED (RIME/GLAZE)

TS = -24.
 CDBASE = .0085

$$\begin{aligned}
 \text{DELCD} &= \text{CDBASE} * [.158 * \text{ALOG (KOC)} + 175.0 * \text{AC} * \text{EM} \\
 &\quad * \text{SCA}^{**.2} / \text{SCA}^{** 1.2} + 1.70] * (\text{ALF} + 6) / 10 \\
 &= .0085 * [.158 * \ln (.001) + 175 * .038 * .37 * 1 \\
 &\quad + 1.7] * (12) / 10 \\
 &= .0314
 \end{aligned}$$

 CDSAVE = .0314
 KD = 0
 KD1 = 1
 DCDTMR = 0

$$\begin{aligned}
 \text{DELCD} &= \text{KD1} * [(.00686 * \text{AKZERO} * \text{TOC}^{** 1.5} * (\text{ALF} + 6) + \text{DCDTMR} \\
 &\quad - .0313 * \text{ROC}^{** 2}) * \text{W} * \text{CTAU} * \text{SCA}^{** .2} / \text{SCA}^{** 1.2}] \\
 &= 1[(.00686 * .283 * 12^{1.5} * 12 + 0 - .0313 * .0158^2) \\
 &\quad * (.75 * 55.2 * 1)] \\
 &= .0398
 \end{aligned}$$

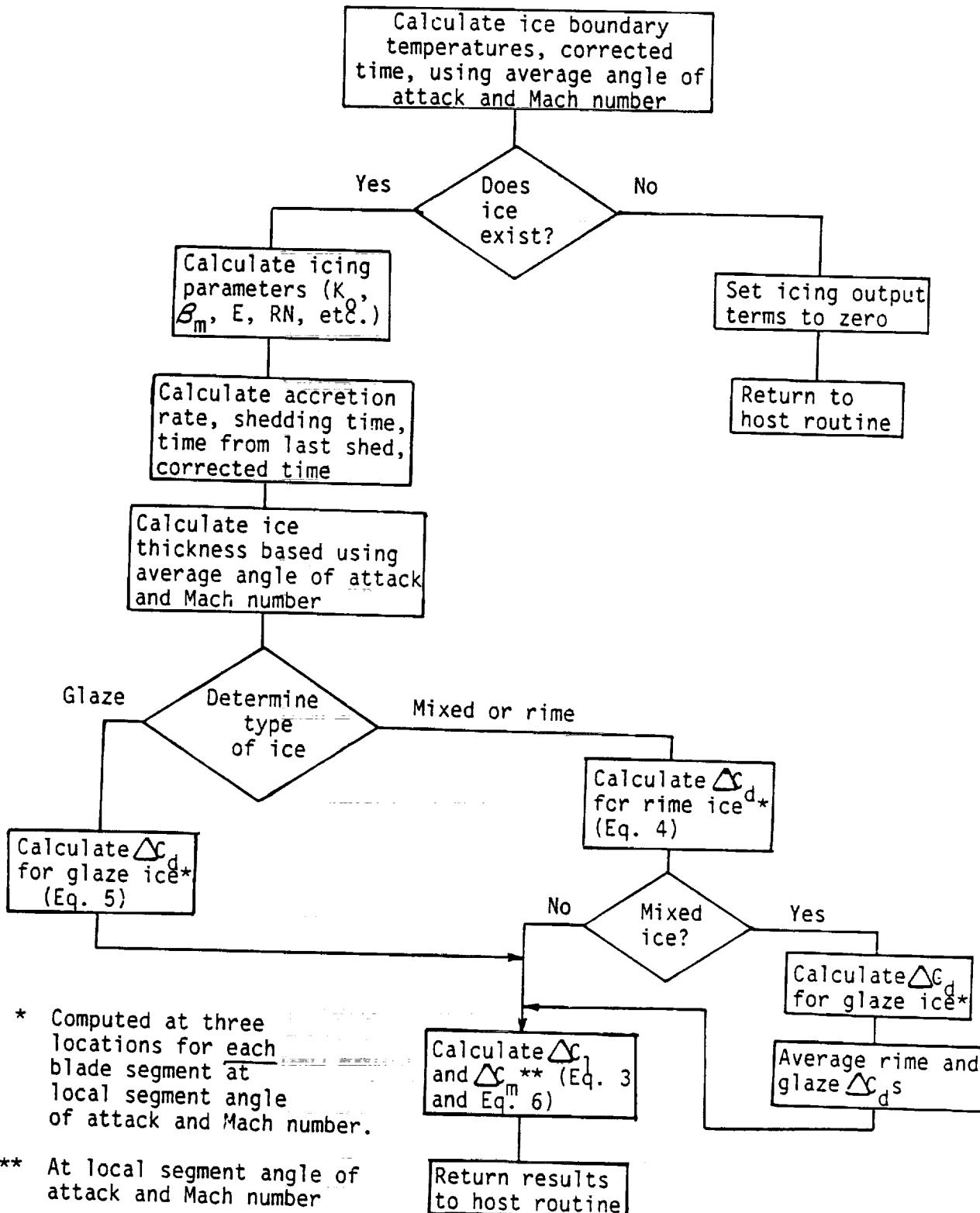
$$\begin{aligned}
 \text{DELCD} &= \text{CDSAVE} - (\text{DELCD} - \text{CDSAVE}) * (\text{TRIME} - 2 - \text{TS}) / 4 \\
 &= .0314 - (.0398 - .0314) * (-24.19 - 2 + 24) / 4 \\
 &= .0360
 \end{aligned}$$

APPENDIX G

Rotorcraft Icing Prediction subroutine

The computer subroutine used to predict the rotor icing penalties contained in this report is contained in this appendix. The subroutine is designed to be included in hover or forward flight prediction codes, in combination with user supplied output logic. A test program and test case output follow the subroutine code in this appendix.

APPENDIX G (CONT)
SIMPLIFIED FLOW DIAGRAM
SUBROUTINE TO COMPUTE ROTORCRAFT ICING INCREMENTS



APPENDIX 6 (CONT)

```

C THIS SUBROUTINE DETERMINES THE ICE ACCRETION ON AN AIRFOIL EXPOSED
C TO SPECIFIED ICING CONDITIONS AND CALCULATES THE LIFT AND DRAG
C PENALTIES DUE TO THE ICE FORMATION.
C
C PROGRAMMED BY THE SIKORSKY AIRCRAFT DIVISION, UTC, MAY 1984
C
C EQUATIONS ARE BASED ON THE RESULTS OF 1982 AND 1983 NRC HIGH SPEED
C ICING WIND TUNNEL TESTS FUNDED UNDER NASA CONTRACT NAS3-23049
C
C      SUBROUTINE DELICE(CL,CD,VELF,VELFT,CRDF,ALPHA,ALPHT,TOC,RHO,
C      1 OMEGAR,SOUND,W,TAU,DD,ISECT,ISWITC,ROC,PCSW,SHEEP,
C      2 RAD,R,SHED,DX,OSC,PTYP,VHELO,CLOUD,KPSI)
C      COMMON/ICEPR1/OAT,TIME(15),TEMP(15),CRED(15),CRKZ(15),CROC(15),
C      1 CEM(15),CBETA(15),CHT(15),CDELCL(73,15),CDELCD(73,15),CTOC(15),
C      2 CFFRAC(15),CARATE(15),CCENTF(15),CALPHA(15),CVELF(15),REQTIM(15),
C      3 TIMESH(15)
C      COMMON/TEST/TONSET,TGL,RTEMPC,STEMPC,DELCD1,DELCD2
C
C      SUBROUTINE INPUTS
C      CL   BASE LIFT COEFFICIENT
C      CD   BASE DRAG COEFFICIENT
C      VELF AVERAGE SEGMENT VELOCITY NORMAL TO QUARTER CHORD, FPS
C      VELFT LOCAL SEGMENT VELOCITY NORMAL TO QUARTER CHORD, FPS
C      CRDF SEGMENT BLADE CHORD, FT
C      ALPHA AVERAGE SEGMENT ANGLE OF ATTACK, DEG
C      ALPHT LOCAL SEGMENT ANGLE OF ATTACK, DEG
C      TOC   SEGMENT THICKNESS TO CHORD RATIO
C      ROC   SEGMENT LEADING EDGE RADIUS TO CHORD RATIO
C      RHO   ATMOSPHERIC DENSITY, SLUGS PER CUBIC FOOT
C      OMEGAR ROTOR TIP SPEED, FPS
C      SOUND SPEED OF SOUND, FPS
C      W    LIQUID WATER CONTENT, GRAMS PER CUBIC METER
C      TAU   ICING TIME, SECONDS
C      DD    MEDIAN VOLUMETRIC DROPLET DIAMETER, MICRONS
C      ISECT BLADE SEGMENT INDEX
C      ISWITC CYCLE SWITCH FOR EITHER CL OR CD CALCULATIONS
C           =0 FOR DELCL AND DELCD CALCULATIONS
C           =1 FOR DELCD CALCULATIONS
C           =2 FOR DELCL CALCULATIONS
C      PCSW FRACTION OF BLADE THAT IS SWEPT
C      SHEEP SWEEP ANGLE, DEG
C      RAD   SEGMENT POSITION AS A FRACTION OF BLADE RADIUS
C      DX    SEGMENT LENGTH AS A FRACTION OF BLADE RADIUS
C      R     BLADE RADIUS
C      SHED  SHEDDING INDEX
C      OSC   OSCILLATION (=0. FOR NO OSCILLATION, =1. FOR OSCILLATION)
C      VHELO HELICOPTER FLIGHT SPEED (KNOTS)
C      CLOUD CLOUD LOWER TEMPERATURE LIMIT CRITERIA
C           =1. FOR NO LIMIT
C           =2. FOR FAR 25 INTERMITTENT MAXIMUM LIMIT
C           =3. FOR FAR 25 MAXIMUM CONTINUOUS LIMIT
C           =4. FOR DOT/FAA/CT-83/22 LIMIT
C      PTYP  POSITION OF CALCULATION POINT WITHIN BLADE SEGMENT
C
C      OUTPUT BLADE SEGMENT QUANTITIES (FOR SEGMENT ISECT)
C      TIME  ICING TIME INCLUDING EFFECTS OF SHEDDING, SECONDS
C      REQTIM INPUT ICING TIME
C      TIMESH ICING TIME FOR WHICH A SHED WILL OCCUR
C      TEMP  CORRECTED TEMPERATURE, DEG C

```

APPENDIX 6 (CONT)

```

C      CRED   DROPLET REYNOLDS NUMBER
C      CRKZ   MODIFIED INERTIA PARAMETER
C      CEM    MEAN COLLECTION EFFICIENCY
C      CBETA  MAXIMUM COLLECTION EFFICIENCY
C      CHT    ICE THICKNESS, INCHES
C      CFFRAC FREEZING FRACTION
C      CARATE ICE ACCRETION RATE
C      CCENTF CENTRIFUGAL FORCE
C      CDELCL LIFT COEFFICIENT INCREMENT DUE TO ICE
C      CDELCD DRAG COEFFICIENT INCREMENT DUE TO ICE
C      CTOC   TOC
C      CROC   ROC
C      CALPHA MEAN ANGLE OF ATTACK, DEG
C      CVELF  MEAN VELOCITY, FPS
C
C      C FACTOR TIME
        TAUFR=1.0/EXP(.00139*TAU)
        CTAU=TAU*TAUFR
        IF(TAU .GE. 600.)CTAU=260.+49.77*( ALOG(TAU)-6.397)
        TAUSAV=TAU
C ESTABLISH SCALING (BASIC EQUATIONS DEVELOPED FOR A CHORD OF 0.5 FEET)
        SCALE=CRDF/0.5
        SW=W*SCALE**.2
        STAU=CTAU/SCALE**1.2
        SDD=DD
C ESTABLISH TEMPERATURES
        STEMPC=(SOUND**2/2403.1862-491.67)/1.8
        STEMPK=STEMPC+273.15
        DAT=STEMPC
        HMU=3.07244E-8*STEMPK**1.5/(STEMPK+114.)
C RESOLVE VELOCITY FOR SWEEP TIPS (NOT REQUIRED FOR SIKORSKY CCHAP)
        IF(PTYP .EQ. .5)GO TO 5
        PSW=1.0-PCSW
        RSWEEP=SWEET*.0174533
        IF(RAD .LT. PSW)GO TO 5
        VELFT=VELFT/COS(RSWEEP)
C CHECK THE VELOCITY
        5 IF(VELFT .LE. 0.0)GO TO 300
        IF(VELF .LE. 0.0)GO TO 300
C CHECK THE ANGLE OF ATTACK
        IF(ABS(ALPHA) .GT. 45.0)GO TO 300
        IF(ALPHA .LT. -2.0)ALPHA=ABS(ALPHA)-4.
        IF(ALPHA .GT. 15.0)ALPHA=15.0
        IF(ABS(ALPHT) .GT. 45.0)GO TO 300
        IF(ALPHT .LT. -2.0)ALPHT=ABS(ALPHT)-4.
        IF(ALPHT .GT. 15.0)ALPHT=15.0
C CALCULATE RECOVERY FACTOR AND RIME BOUNDARY BASED ON NRC TESTS
        RMACH=VELF/SOUND
        RMACHT=VELFT/SOUND
        REC=.0944*RMACH*W**2+.385*RMACH*W+.98*RMACH**3-
        + 1.33*RMACH-.0283*W**2-.115*W+1.077
        IF(REC.GT.1.)REC=1.
        RTEMPC=(224.79*W**2-326.25*W+35.59)*RMACH**2
        1 +(-83.05*W**2+57.73*W-26.38)*RMACH
C CORRECTION OF STAGNATION TEMPERATURE FOR DROPLET COOLING EFFECTS
        CTEMPK=(STEMPK-.33*(ALPHA-6.))*(1.0+.2*REC*RMACH**2)
        CTEMPC=CTEMPK-273.15
        IF(CTEMPC.LT.STEMPC)CTEMPC=STEMPC
        TONSET=273.15/(1.+.2*REC*RMACH**2)-273.15+.33*(ALPHA-6.)
        TGL=TONSET-.33*ALPHA
C CLOUD HIGH TEMPERATURE CRITERIA
        IF(CTEMPC.GE.0.OR.SW.LE.0.)GO TO 300
C CLOUD LOW TEMPERATURE CRITERIA
        ICLOUD=INT(CLOUD+.001)
        IF(ICLOUD.LT.1.OR.ICLOUD.GT.4)ICLOUD=1
        IF(VHELO.LT.1.)ICLOUD=1

```

APPENDIX 6 (CONT)

```

EXTENT=VHELO*TAU/3600.
GO TO (40,10,20,30),ICLOUD
10 F=-.0328*(ALOG(EXTENT))**2-.1649*ALOG(EXTENT)+1.1875
WMAX=F*(-.000875*STEMPC**2+.03125*STEMPC+2.9)
IF(W.LE.WMAX)GO TO 40
GO TO 300
20 F=-.3040*ALOG(EXTENT)+1.87
WMAX=F*(0.8-.02*STEMPC)
IF(W.LE.WMAX)GO TO 40
GO TO 300
30 IF(STEMPC.GE.-15..AND.W.LE.1.74)GO TO 40
IF(STEMPC.LT.-15..AND.STEMPC.GE.-20..AND.W.LE.0.66)GO TO 40
IF(STEMPC.LT.-20..AND.STEMPC.GE.-25..AND.W.LE.0.41)GO TO 40
GO TO 300
40 CONTINUE
RED=3.2795E-6*SDD*RHO*VELF/HMU
RK=1.1625E-12*VELF*SDD**2/(HMU*CRDF)
RKZ=RK/(1.0+.0967*RED**.6367)
BETA=.1423*ALOG(RKZ)-25.13*TOC**2+1.772*TOC+1.2645
IF(BETA.LE.0.0)GO TO 300
IF(BETA.GT.1.0)BETA=1.0
EM=.08686*ALOG(RKZ)+.6111*TOC**2-.7433*TOC+.5600

C
C FIGURE THE FREEZING FRACTION
IF(RTEMPG.GE.TONSET)FFRAC=1.0
IF(RTEMPG.GE.TONSET)GO TO 60
FFRAC1=(STEMPC-TONSET)/(RTEMPG-TONSET)
FFRAC=1.0-.9242*EXP(-FFRAC1)
IF(FFRAC.LE.0.0)GO TO 300
IF(FFRAC.GT.1.0)FFRAC=1.0
C CALCULATE ACCRETION RATE, ICE THICKNESS AND CENTRIFUGAL FORCE
60 ARATE=FFRAC*BETA*W*VELF*TOC*CRDF*.0000624
CENTFI=ARATE*(OMEGAR*RAD)**2/(RAD*R*32.174)
SHEDCR=SHED*CTEMPG
C CALCULATE TIME TO A SHED BASED ON CORRECTED TIME
CTAUS=SHEDCR/CENTFI
IF(CTAUS.GT.2000.)CTAUS=2000.
ALCT=ALOG(1.+CTAUS/100.)
TAUS=CTAUS/(4.659*ALCT-8.104*ALCT**2+4.891*ALCT**3-.727*ALCT**5)
IF(CTAUS.GE.260.)TAUS=EXP((CTAUS-260.)/49.77+6.397)
IF(TAU.GT.7200.)TAUS=7200.
TAU=TAU-TAUS*INT(TAU/TAUS)
TAUFTR=1.0/EXP(.00139*TAU)
CTAU=TAU*TAUFTR
IF(TAU.GE.600.)CTAU=260.+49.77*(ALOG(TAU)-6.397)
AP=ARATE*CTAU/54.912
IF(STEMPG.LT.TGL)GO TO 70
BASE=.2*FFRAC
THK=48.*AP/(BASE*CRDF)
GO TO 90
70 CONTINUE
AREA=.01854*TOC
AFTHK=.7968*TOC
AALE=.00435/RMACH
FST=(AFTHK*.08-AREA+AFTHK*AALE)*CRDF**2
IF(AP.GT.FST)GO TO 80
A1=568.136*AALE**2-28.776*AALE+.473
B1=-131.142*AALE**2+4.846*AALE+.010
THK=(-B1+SQRT(B1**2+4.*A1*AP/CRDF**2))/2./A1
THK=12.*THK*TOC*CRDF*EXP(-.3067*FFRAC)/.095
GO TO 85
80 THK=12.*(AP+AREA*CRDF**2)/(AFTHK*CRDF)
85 CONTINUE
C EMPIRICAL ICE THICKNESS CORRECTION
CTHK=-.0709
IF(THK.LT..10)CTHK=-.709*THK

```

APPENDIX G (CONT)

```

THK=(THK+CTHK)/(1.-.00426/TOC**2.1)
90 IF(ARATE .LE. 0.0)THK=0.0
      STAU=CTAU/SCALE**1.2
C NO ICE FORMATION ON THE LAST ONE PERCENT OF THE BLADE SPAN
      IF(RAD .GE. .98)STAU=STAU*(DX-.01)/DX
C DEFINE A K ZERO BASED ON THE LOCAL VELOCITY TO BE CONSISTENT WITH
C THE ASSUMPTION THAT CL AND CD ARE CALCULATED BASED ON THE LOCAL
C CONDITIONS
      RKZT=RKZ*VELFT/VELF
      IF(ISWITC .EQ. 1)GO TO 110
C LIFT CORRECTION TERMS
      RKL=.67
      RKL1=1.
      IF(STEMPC .GT. RTEMPC .AND. STEMPC .LT. TGL)
1     RKL=.67*(1.+(STEMPC-RTEMPC)/(TGL-RTEMPC))
      IF(STEMPC .GE. TGL .AND. STEMPC .LT. TONSET)
1     RKL=1.33*(1.-(STEMPC-TGL)/(TONSET-TGL))
      IF(ALPHT .LE. 6.)RKL1=0.
C DELCL FOR GLAZE AND RIME FROM FIT OF 1982 NRC TUNNEL DATA
      DELCL=(-.01335*RKZT*TOC*((ALPHT+2.)*RKL*.00555*
1     (ALPHT-6.))**2)*RKL*SW*STAU
C OSCILLATION EFFECTS
      DELCL=DELCL*(1.0+0.*OSC*VHELO/150.)
      CL=CL+DELCL
      CDELCL(KPSI,ISECT)=DELCL
      IF(ISWITC.EQ.2)GO TO 310
C GLAZE DELCD FROM FIT OF 1982 NRC TUNNEL DATA
C AND AVERAGED ACROSS THE SEGMENT
110  IF(STEMPC.LT.RTEMPC-2.)GO TO 120
      CSAVE=0.
C CALCULATION OF AVERAGE SECTION DELTA CD FOR GLAZE ICING
C DELCD AT NORMAL BLADE SECTION CALCULATION POINT
      RKDB=1.0
      RKD=0.
      IF(STEMPC .GT. TGL-8. .AND. STEMPC .LT. TGL)
1     RKD=((STEMPC-TGL+8.)/8.)**2
      IF(STEMPC .GE. TGL .AND. STEMPC .LT. TONSET)
1     RKD=1.0
      IF(STEMPC .GE. TGL .AND. STEMPC .LT. TONSET)
1     RKDB=-(STEMPC-TONSET)/(TONSET-TGL)
      DCDTMRKD=.006*RMACHT**2.4
      DELCDC=RKDB*(.00686*RKZT*TOC**1.5*(ALPHT+6.)*DCDTMP-
1     ((ROC)**2)/32.)*SW*STAU
C DELCD AT INBOARD END OF BLADE SEGMENT
      DX1=DX*PTYP
      RMACH1=(RMACH-VHELO*1.688/SOUND)*(RAD-DX1)/RAD+VHELO*1.688/SOUND
      RMACT1=(RMACH-VHELO*1.688/SOUND)*(RAD-DX1)/RAD+VHELO*1.688/SOUND
      RKZ1=RKZ*RMACT1/RMACHT
      REC1=.0944*RMACH1**2+.385*RMACH1*W+.98*RMACH1**3-
+ 1.33*RMACH1-.0283*W**2-.115*W+1.077
      RTEMK1=273.15/(1.+.2*REC1*RMACH1**2)
      RTEMC1=RTEMK1-273.15
      TGL1=RTEMC1-.33*ALPHT
      RKDB1=1.0
      RKD1=0.
      IF(STEMPC .GT. TGL1-8. .AND. STEMPC .LT. TGL1)
1     RKD1=((STEMPC-TGL1+8.)/8.)**2
      IF(STEMPC .GE. TGL1 .AND. STEMPC .LT. RTEMC1)
1     RKD1=1.0
      IF(STEMPC .GE. TGL1 .AND. STEMPC .LT. RTEMC1)
1     RKDB1=-(STEMPC-RTEMC1)/(RTEMC1-TGL1)
      DCDTM1=RKD1*.006*RMACH1**2.4
      DELCD1=RKDB1*(.00686*RKZ1*TOC**1.5*(ALPHT+6.)*DCDTM1-
1     ((ROC)**2)/32.)*SW*STAU
C DELCD AT OUTBOARD END OF BLADE SEGMENT
      DX2=DX*(1.-PTYP)

```

APPENDIX 6 (CONT)

```

RMACH2=(RMACH-VHELO*1.688/SOUND)*(RAD+DX2)/RAD+VHELO*1.688/SOUND
RMACT2=(RMACHT-VHELO*1.688/SOUND)*(RAD+DX2)/RAD+VHELO*1.688/SOUND
RKZ2=RKZ*RMACT2/RMACH
REC2=.0944*RMACH2*W**2+.385*RMACH2*W+.98*RMACH2**3-
+ 1.33*RMACH2-.0283*W**2-.115*W+1.077
RTEMK2=273.15/(1.+.2*REC2*RMACH2**2)
RTEMC2=RTEMK2-273.15
TGL2=RTEMC2-.33*ALPH
RKDB2=1.0
RKD2=0
IF(STEMPC .GT. TGL2-8. .AND. STEMPC .LT. TGL2)
1 RKD2=((STEMPC-TGL2+8.)/8.)**2
IF(STEMPC .GE. TGL2 .AND. STEMPC .LT. RTEMC2)
1 RKD2=1.0
IF(STEMPC .GE. TGL2 .AND. STEMPC .LT. RTEMC2)
1 RKD2=(STEMPC-RTEMC2)/(RTEMC2-TGL2)
1 DCDTM2=RKDB2*(.006*RMACH2**2.4
1 DELCD2=RKDB2*(.00686*RKZ2*TOC**1.5*(ALPH+6.))+DCDTM2-
1 ((ROC)**2/32.)*SW*STAU
1 DELCD=DELCD1*PTYP/2.+DELCD*5.+DELCD2*(1.-PTYP)/2.
IF(STEMPC.GE.RTEMPG-2.)GO TO 130
CDSAVE=DELCD
C RIME DRAG -BRAGG FORMAT MODIFIED USING 1982 NRC TUNNEL DATA
120 AKOC=.001
AC=VELFT*W*CTAU/CRDF/880000.
CDBASE=CD
IF(CDBASE.GT.0.0210)CDBASE=.0210
1 DELCD=CDBASE*(1.158*ALOG(AKOC)+175.*AC*EM/SCALE+1.7)*(ALPH+6.)/10.
IF(STEMPC.LT.RTEMPG-2.)GO TO 130
1 DELCD=DELCD-(CDSAVE-DELCD)*(RTEMPG-2.-STEMPC)/4.
130 CONTINUE
C OSCILLATION EFFECTS
OSCDCD=8.*DELCD*OSC*VHELO/150.
IF(OSCDCD.GT..4)OSCDCD=.4
1 DELCD=DELCD*(1.0-OSCDCD)
CD=CD+DELCD
CDELCD(KPSI,ISECT)=DELCD
GO TO 310
C OUTPUT INTERFACING
C IF THE TEMPERATURE IS TOO HIGH OR TOO LOW FOR ICE TO FORM, ALL
C THE OUTPUT PARAMETERS ARE SET TO ZERO
300 CRED(ISECT)=0.0
CRKZ(ISECT)=0.0
CEM(ISECT)=0.0
CBETA(ISECT)=0.0
CHT(ISECT)=0.0
CFFRAC(ISECT)=0.0
CARATE(ISECT)=0.0
CCENTF(ISECT)=0.0
TIME(ISECT)=0.0
TIMESH(ISECT)=0.0
CDELCL(KPSI,ISECT)=0.0
CDELCD(KPSI,ISECT)=0.0
GO TO 320
310 CRED(ISECT)=RED
CRKZ(ISECT)=RKZ
CEM(ISECT)=EM
CBETA(ISECT)=BETA
CHT(ISECT)=THK
CFFRAC(ISECT)=FFRAC
CARATE(ISECT)=ARATE
CCENTF(ISECT)=CENTF1*CTAU
TIME(ISECT)=TAU
TIMESH(ISECT)=TAUS
320 CONTINUE
CALPHA(ISECT)=ALPHA

```

APPENDIX G (CONT)

```

C VELF(ISECT)=VELF
C REQTIM(ISECT)=TAUSAV
C TEMP(ISECT)=CTEMPC
C ROC(ISECT)=ROC
C TOC(ISECT)=TOC
C RETURN
C END

C THIS PROGRAM HAS BEEN PREPARED TO RUN A TEST CASE FOR
C SUBROUTINE ROTICE
C
C PROGRAMMED BY THE SIKORSKY AIRCRAFT DIVISION, UTC, MAY 1984
C
C
C SUBROUTINE INPUTS
C CL   BASE LIFT COEFFICIENT
C CD   BASE DRAG COEFFICIENT
C VELF  AVERAGE SEGMENT VELOCITY NORMAL TO QUARTER CHORD, FPS
C VELFT LOCAL SEGMENT VELOCITY NORMAL TO QUARTER CHORD, FPS
C CRDF  SEGMENT BLADE CHORD, FT
C ALPHA AVERAGE SEGMENT ANGLE OF ATTACK, DEG
C ALPHT LOCAL SEGMENT ANGLE OF ATTACK, DEG
C TOC  SEGMENT THICKNESS TO CHORD RATIO
C ROC  SEGMENT LEADING EDGE RADIUS TO CHORD RATIO
C RHO  ATMOSPHERIC DENSITY, SLUGS PER CUBIC FOOT
C OMEGAR ROTOR TIP SPEED, FPS
C SOUND SPEED OF SOUND, FPS
C W    LIQUID WATER CONTENT, GRAMS PER CUBIC METER
C TAU  ICING TIME, SECONDS
C DD   MEDIAN VOLUMETRIC DROPLET DIAMETER, MICRONS
C ISECT BLADE SEGMENT INDEX
C ISWITC CYCLE SWITCH FOR EITHER CL OR CD CALCULATIONS
C      =0 FOR DELCL AND DELCD CALCULATIONS
C      =1 FOR DELCD CALCULATIONS
C      =2 FOR DELCL CALCULATIONS
C PCSW FRACTION OF BLADE THAT IS SWEEPED
C SWEEP SWEEP ANGLE, DEG
C RAD  SEGMENT POSITION AS A FRACTION OF BLADE RADIUS
C DX   SEGMENT LENGTH AS A FRACTION OF BLADE RADIUS
C R    BLADE RADIUS
C SHED SHEDDING INDEX
C OSC  OSCILLATION (=0. FOR NO OSCILLATION, =1. FOR OSCILLATION)
C VHELO HELICOPTER FLIGHT SPEED (KM/HOUR)
C CLOUD CLOUD LOWER TEMPERATURE LIMIT CRITERIA
C      =1. FOR NO LIMIT
C      =2. FOR FAR 25 INTERMITTENT MAXIMUM LIMIT
C      =3. FOR FAR 25 MAXIMUM CONTINUOUS LIMIT
C      =4. FOR DOT/FAA/CT-83/22 LIMIT
C PTYP POSITION OF CALCULATION POINT WITHIN BLADE SEGMENT
C
C OUTPUT BLADE SEGMENT QUANTITIES (FOR SEGMENT ISECT)
C TIME  ICING TIME INCLUDING EFFECTS OF SHEDDING, SECONDS
C REQTIM INPUT ICING TIME
C TEMP  CORRECTED TEMPERATURE, DEG C
C CREND DROPLET REYNOLDS NUMBER
C CRKZ  MODIFIED INERTIA PARAMETER
C CEM   MEAN COLLECTION EFFICIENCY
C CBETA MAXIMUM COLLECTION EFFICIENCY
C CHT   ICE THICKNESS, INCHES
C CFFRAC FREEZING FRACTION
C CARATE ICE ACCRETION RATE
C CCENTF CENTRIFUGAL FORCE
C CDELCL LIFT COEFFICIENT INCREMENT DUE TO ICE
C CDELCD DRAG COEFFICIENT INCREMENT DUE TO ICE
C TOC   TOC

```

APPENDIX G (CONT)

```

C CROC ROC
C CALPHA MEAN ANGLE OF ATTACK, DEG
C CVELF MEAN VELOCITY, FPS
C
C COMMON/ICEPRT/OAT,TIME(15),TEMP(15),CRED(15),CRKZ(15),CROC(15),
1 CEM(15),CBETA(15),CHT(15),CDELCL(15),CDELCD(15),CTOC(15),
2 CFFRAC(15),CARATE(15),CCENTF(15),CALPHA(15),CVELF(15),REQTIM(15)
COMMON/TEST/TONSET,TGLAZE,TRIME,STEMPC,DELCD1,DELCD2
REAL M
WRITE(6,2)
2 FORMAT(' T CORR      LWC      DELCL      DELCD      THK      AL
1 PHA      VEL      T ONSET      T GLAZE      T RIME      T STATIC      DELCD1      DE
2 LCD2')
3 ,      DEG C      G/CU M      IN      D
4EG      FPS      DEG C      DEG C      DEG C      DEG C')
CRDF=.1524/.3048
TOC=.12
ROC=.0158
ALPHA=6.
ALPHt=6.
RHO=.00262327
SOUND=1062.86
OMEGAR=675.
ISECT=10
ISWITC=0
PCSW=.95
SWEEP=25.
RAD=.91
R=22.
SHED=-12.
DX=.02
PTYP=.5
VELF=414.51
VELFT=414.51
OSC=0.
VHELO=0.
CLOUD=1.
DO=20.
TAU=60.
DO 5 J=1,7
CD=.0085
CL=.6
W=.25+(J-1)*.25
CALL DELICE(CL,CD,VELF,VELFT,CRDF,ALPHA,ALPHt,TOC,RHO,
1 OMEGAR,SOUND,W,TAU,DO,ISECT,ISWITC,ROC,PCSW,SWEEP,
2 RAD,R,SHED,DX,OSC,PTYP,VHELO,CLOUD,DUMMY)
WRITE(6,10)TEMP(ISECT),W,CDELCL(ISECT),CDELCD(ISECT),CHT(ISECT),
1 CALPHA(ISECT),CVELF(ISECT),TONSET,TGLAZE,TRIME,STEMPC,
2 DELCD1,DELCD2
10 FORMAT(1H ,2F10.2,3F10.4,6F10.2,2F10.4)
5 CONTINUE
W=.75
DO 6 J=1,16
CD=.0085
CL=.6
SOUND=1025.57+(J-1)*4.1433
RHO=.00262327*261.15/(243.15+(J-1)*2)
VELF=414.51*SOUND/1062.85
VELFT=414.51*SOUND/1062.85
CALL DELICE(CL,CD,VELF,VELFT,CRDF,ALPHA,ALPHt,TOC,RHO,
1 OMEGAR,SOUND,W,TAU,DO,ISECT,ISWITC,ROC,PCSW,SWEEP,
2 RAD,R,SHED,DX,OSC,PTYP,VHELO,CLCUD,DUMMY)
WRITE(6,10)TEMP(ISECT),W,CDELCL(ISECT),CDELCD(ISECT),CHT(ISECT),
1 CALPHA(ISECT),CVELF(ISECT),TONSET,TGLAZE,TRIME,STEMPC,
2 DELCD1,DELCD2
6 CONTINUE
STOP
END

```

APPENDIX G (CONT)

T CORR DEG C	LWC g/CU M	VEL IN DEG C	THK IN DEG C	DELCL DELCD	ALPHA DEG DEG C	VEL FPS DEG C	T ONSET DEG C	T GLAZE DEG C	T RIME DEG C	T STATIC DEG C	DELCD1 DEG C	DELCD2 DEG C
-7.03	0.25	-0.0341	0.0148	0.0745	6.00	414.51	-5.10	-7.08	-11.54	-12.00	0.0145	0.0150
-6.95	0.50	-0.1058	0.0297	0.1489	6.00	414.51	-5.19	-7.17	-17.98	-12.00	0.0291	0.0302
-6.85	0.75	-0.1758	0.0447	0.1947	6.00	414.51	-5.28	-7.26	-24.19	-12.00	0.0439	0.0455
-6.76	1.00	-0.2449	0.0600	0.2299	6.00	414.51	-5.38	-7.36	-30.18	-12.00	0.0589	0.0611
-6.65	1.25	-0.3136	0.0755	0.2598	6.00	414.51	-5.49	-7.47	-35.95	-12.00	0.0740	0.0770
-6.53	1.50	-0.3923	0.0913	0.2865	6.00	414.51	-5.60	-7.58	-41.48	-12.00	0.0894	0.0931
-6.41	1.75	-0.4509	0.1073	0.3111	6.00	414.51	-5.73	-7.71	-46.80	-12.00	0.1051	0.1096
-25.21	0.75	-0.1000	0.0310	0.3927	6.00	399.97	-5.28	-7.26	-24.19	-30.00	0.1051	0.1096
-23.21	0.75	-0.1002	0.0311	0.3832	6.00	401.59	-5.28	-7.26	-24.19	-28.03	0.1051	0.1096
-21.19	0.75	-0.1005	0.0315	0.3778	6.00	403.20	-5.28	-7.26	-24.19	-26.06	0.0393	0.0402
-19.17	0.75	-0.1015	0.0359	0.3583	6.00	404.82	-5.28	-7.26	-24.19	-24.07	0.0394	0.0403
-17.13	0.75	-0.1136	0.0399	0.3421	6.00	406.43	-5.28	-7.26	-24.19	-22.08	0.0395	0.0404
-15.09	0.75	-0.1258	0.0400	0.3227	6.00	408.05	-5.28	-7.26	-24.19	-20.08	0.0396	0.0405
-13.05	0.75	-0.1382	0.0401	0.2993	6.00	409.67	-5.28	-7.26	-24.19	-18.07	0.0397	0.0406
-10.99	0.75	-0.1506	0.0402	0.2711	6.00	411.28	-5.28	-7.26	-24.19	-16.06	0.0398	0.0407
-8.93	0.75	-0.1632	0.0409	0.2358	6.00	412.90	-5.28	-7.26	-24.19	-14.03	0.0404	0.0415
-6.85	0.75	-0.1758	0.0447	0.1947	6.00	414.51	-5.28	-7.26	-24.19	-12.00	0.0439	0.0455
-4.77	0.75	-0.1886	0.0519	0.1428	6.00	416.13	-5.28	-7.26	-24.19	-9.96	0.0507	0.0531
-2.69	0.75	-0.2015	0.0625	0.0778	6.00	417.75	-5.28	-7.26	-24.19	-7.91	0.0609	0.0641
-0.59	0.75	-0.0597	0.0194	0.5335	6.00	419.36	-5.28	-7.26	-24.19	-5.86	0.0223	0.0165
1.51	0.75	0.0	0.0	0.0	6.00	420.98	-5.28	-7.26	-24.19	-3.79	0.0223	0.0165
3.63	0.75	0.0	0.0	0.0	6.00	422.59	-5.28	-7.26	-24.19	-1.72	0.0223	0.0165
5.75	0.75	0.0	0.0	0.0	6.00	424.21	-5.28	-7.26	-24.19	0.36	0.0223	0.0165

APPENDIX H

SYMBOLS

$A, B, K_L, K_{L1}, K_D, K_{D1}$	Empirical constants
A	Accretion rate,
c	Airfoil chord, m (ft)
C_d	Drag coefficient
C_l	Lift coefficient
C_m	Pitching moment coefficient
C_p	Pressure coefficient
D_d	Droplet diameter, μm
E	Total airfoil collection efficiency
f	$(T_s - T_{ON}) / (T_R - T_{ON})$
k/c	Roughness height to chord ratio
K	Inertia parameter
K_o	Modified inertia parameter
M	Free stream Mach number
r	Empirically derived thermodynamic recovery factor
r/c	Airfoil leading edge radius to chord ratio
l_{int}	Ice adhesion width (interior ice thickness), m (in)
t/c	Airfoil thickness to chord ratio
T_c	Corrected temperature, $^{\circ}\text{C}$
T_{GL}	Glaze ice boundary static temperature (T_{glaze}), $^{\circ}\text{C}$
T_{ON}	Onset of ice static temperature, $^{\circ}\text{C}$

APPENDIX H (Cont'd)

Symbols (Cont'd)

T_R	Rime ice boundary static temperature, °C
T_s	Static temperature, °C
T_t	Total temperature, °C
V	Local velocity, mps (fps)
V_{HELO}	Helicopter forward flight speed, km/hr (knots)
W	Liquid water content g/m³
α	Airfoil angle of attack, deg
β_m	Maximum local collection efficiency
γ	Ratio of specific heats
Δ	Incremental quantity
ρ_I	Ice density, kg/m³
τ	Icing time, seconds
τ_c	Corrected icing time, seconds

Subscripts

P	Pressure
PL	Plenum
40	At 40% x/c

References

- 1) Lee, J. D.: "Performance of Two Transonic Airfoil Wind Tunnels Utilizing Limited Ventilation," Proceedings of the Wind Tunnel Wall Interference Assessment/Correction Workshop, NASA Langley Research Center, January 1983.
- 2) Freuler, R. J.; and Hoffman, M. J.: Experiences With An Airborne Digital Computer System for General Aviation Flight Testing. AIAA Aircraft Systems and Technology Meeting, Paper 79-1834, August 20-22, 1979.
- 3) Lee, J. D.; Gregorek, G. M.; and Korkan, K. D.: Testing Techniques and Interference Evaluation In the OSU Transonic Airfoil Facility." AIAA 11th Fluid and Plasma Dynamics Conference, Paper 78-1118, July, 1978.
- 4) ____: "Aircraft Icing," AGARD Advisory Report No. 127, November 1978.
- 5) Noonan, K. W. and Bingham, G. J.: "Aerodynamic Characteristics of Three Helicopter Rotor Airfoil Section at Reynolds Numbers from Model Scale to Full Scale at Mach Numbers from 0.35 to 0.90," NASA Technical Paper 1701, 1980.
- 6) Jepson, D. et al: "Analysis and Correlation of Test Data from an Advanced Technology Rotor System", NASA CR-152366, July 1980.
- 7) Bauer, F.; Garabedian, P.; Korn, K.; and Jameson, A.: Supercritical Wing Sections II, Lecture Notes in Economics and Mathematical Systems, Vol. 108, Springer-Verlag, Berlin, 1975.
- 8) Cansdale, J.T.: "Helicopter Rotor Ice Accretion and Protection Research," Paper No. 33, Sixth European Rotorcraft and Powered Lift Aircraft Forum, September 1980.
- 9) Werner, J.B.: "Ice Protection Investigation for Advanced Rotary-Wing Aircraft," USAAMRDL Technical Report 73-38, 1973.
- 10) Bragg, M.B.: "Rime Ice Accretion and Its Effect On Airfoil Performance," NASA Contractor Report 165599, March 1982.
- 11) Gray, V.H.: "Prediction of Aerodynamic Penalties Caused by Ice Formations On Various Airfoils," NASA TN D-2166, February 1964.

References (Cont'd)

- 12) Loughborough, D.L. and Haas, E.G.: "Reduction of the Adhesion of Ice to De-Icer Surfaces," *Journal of the Aeronautical Sciences*, Volume 13, Number 3, March 1946.
- 13) Masters, C.O.: "Characterization of Supercooled Clouds Below 10,000 Feet AGL," DOT/FAA/CT-83/22, June 1983.
- 14) Cosstephens, S.D. and Bragg, M.B.: "Correlations for Airfoil Droplet Impingement Parameters," *Ohio State University Report No. AARL TR-8401*, April 1984.
- 15) Wilson, G.W.: "Helicopter Icing - Testing and Certification," *Journal of the American Helicopter Society*, Vol. 27, No. 2, April 1982.
- 16) Abbott, W.Y. et al: "Evaluation of UH-1H Hover Performance Degradation Caused by Rotor Icing," *USAAEFA Project No. 82-12 Final Report*, August 1983.
- 17) Grohsmeyer, S. and Allison, A.: "CH-53E Icing Tests," to be published.
- 18) Miller, T.L.; Korkan, K.D. and Shaw, R.J.: "Statistical Study of an Airfoil Glaze Ice Drag Coefficient Correlation," *SAE Technical Paper Series Number 830753*, April 1983.
- 19) Beheim, M.A.: "Executive Summary of Aircraft Icing Specialists Workshop," *NASA Conference Publication 2086*, July 1978.
- 20) Hanks, M.L.; Higgins, L.B.; and Diekmann, V.L.: "Artificial and Natural Icing Tests, Production UH-60A Helicopter - Final Report," *USAAEFA Project No. 79-19*, June 1980.

1. Report No. NASA CR-3910	2. Government Accession No.	3. Recipient's Catalog No.	
4. Title and Subtitle High Speed Ice Accretion on Rotorcraft Airfoils		5. Report Date August 1985	
		6. Performing Organization Code	
7. Author(s) Robert J. Flemming and David A. Lednicker		8. Performing Organization Report No. SER-510093	
		10. Work Unit No.	
9. Performing Organization Name and Address United Technologies Corporation Sikorsky Aircraft Division N. Main Street Stratford, Connecticut 06601		11. Contract or Grant No. NAS3-23049	
12. Sponsoring Agency Name and Address National Aeronautics and Space Administration Washington, D.C. 20546		13. Type of Report and Period Covered Contractor Report	
		14. Sponsoring Agency Code 505-45-54 (E-2614)	
15. Supplementary Notes Final report. Project Managers, Robert J. Shaw and G. Paul Richter, Propulsion Systems Division, NASA Lewis Research Center, Cleveland, Ohio 44135.			
16. Abstract A three-phase, high-speed, model scale icing wind tunnel test program has been conducted to measure ice growth and the associated performance degradation for two-dimensional helicopter airfoils over a wide range of angle of attack and Mach number. Prior to these tests conducted in the Canadian National Research Council's High Speed Icing Wind Tunnel and the Ohio State University 6 x 22 Transonic Airfoil Facility, airfoil icing data had either been acquired in low speed wind tunnels or during flight testing. Information from a low speed wind tunnel is useful, but its applicability to the high speed domain was uncertain. Flight testing can provide a good means of determining capabilities and power penalties of a particular rotor design, but conditions cannot be well controlled, do not cover a wide range, and are difficult to observe. High speed icing information, as reported in this report, is necessary to predict the effect of icing on rotor performance and to aid in the design of more efficient ice protection systems. Ice was accreted on ten rotorcraft airfoil models for ranges of liquid water content, temperature, and Mach number at several steady and unsteady angles of attack. The test explored the temperature boundary for the onset of ice accretion, as well as the boundary between wet and dry ice growth. Ice shapes were documented by measurement, photographic, and silicon rubber molding techniques and aerodynamic lift, drag and pitching moment levels were measured. In moderate icing conditions, the airfoil lift at low angles of attack was reduced slightly, with a maximum of about 20% at high angles. The drag coefficients of these airfoils increased in moderate icing at low angles of attack by a factor of 3 to 4 above the drag of a clean airfoil. The drag increment increased for angles of attack above six degrees and higher liquid water contents. The effect of Mach number varied for each airfoil configuration. Airfoil oscillation did not change the lift loss but reduced the drag penalty. The data from this series of tests was used to formulate two-dimensional airfoil section icing relationships for ice thickness and for changes in lift, drag, and pitching moment coefficients. These relationships contain variables that are known to be significant for airfoil icing and include empirical constants and terms to provide a rapid prediction method, with improved accuracy over prior relationships. The two-dimensional relationships have been incorporated into rotorcraft hover and forward flight performance prediction codes, which can then be used to predict aircraft power changes in the icing environment and to optimize the design of rotor deicing systems.			
17. Key Words (Suggested by Author(s)) Helicopter icing; Airfoil icing; Performance degradation; Ice accretion shapes	18. Distribution Statement Unclassified - Distribution limited to U.S. Government agencies and their contractors Restriction changed to Unclassified/Unlimited per DAA modified February 15, 2008, by authority of the NASA Glenn Research Center, Icing Branch Office. Subject Category 02		
19. Security Classif. (of this report) Unclassified	20. Security Classif. (of this page) Unclassified	21. No. of pages 301	22. Price